

Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

APRIL 1991

\$3.00

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NOT FREE TRADE
- GETTING AROUND
WITH MAGLEV
- HOW GLOBAL
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CAN HELP SAVE
THE ENVIRONMENT
- PHOTO ESSAY:
ARE CORAL
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"Grown-ups tell us, 'Just say no.' That's easy for them to say."

"Maybe they forgot what it's like.

"At parties, at school, kids are saying to try this or do that, and they're my friends. I mean how many times can I hear I'm a loser.

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The program is sponsored by the National Federation of State High School Associations, and preliminary results have been extremely encouraging.

To learn more about this program, write to us at IBM, P.O. Box 3974, Dept. 973, Peoria, IL 61614.



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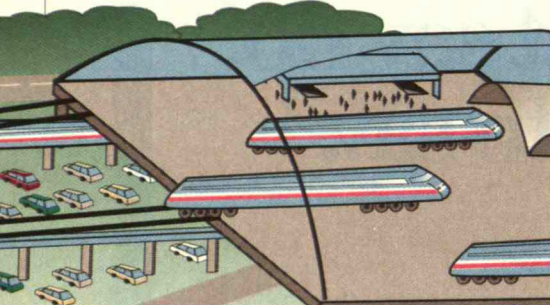
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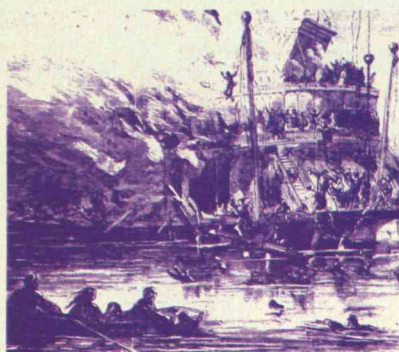


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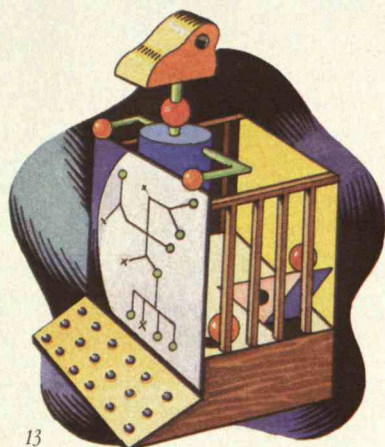
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Illustration: James Yang;

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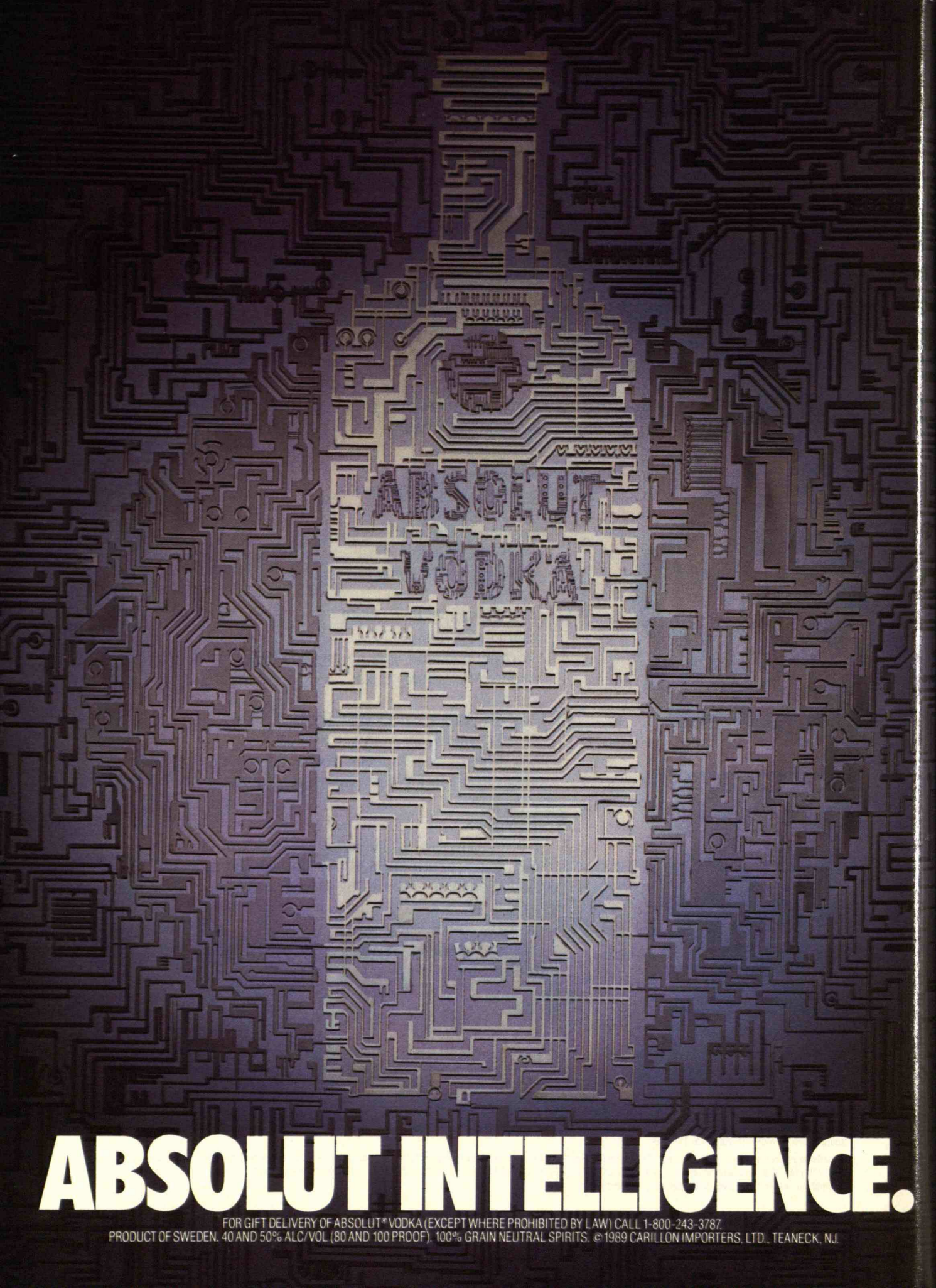
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Editorial, circulation, and advertising offices: *Technology Review*, Building W59, MIT, Cambridge, MA 02139 (617) 253-8250. Printed by Lane Press, Burlington, VT. Second-class postage paid at Boston, MA and additional mailing offices. Postmaster: send address changes to *Technology Review*, MIT, Building W59, Cambridge, MA 02139.

Subscriptions: \$24 per year, libraries and organizations \$27. Canada add \$6, other foreign countries add \$12. Send inquiries to *Technology Review*, P.O. Box 489, Mount Morris, IL 61054. Or call 1-800-435-0715.

Advertising representatives: Mark E. Lynch, Eastern Sales Manager, 9 Salem Dr., Saratoga Springs, NY (518) 583-6086; The Leadership Network, 254 Fifth Ave., New York, NY 10001 (212) 684-5500; James G. Elliott Co., Los Angeles, CA (213) 746-8800; Donald Moeller, Dallas, TX 75226 (214) 559-5730; IMI Corp., Tokyo, Japan; Keith Olson/Media, Birmingham, MI (313) 642-2885; Joan Stapleton, Washington, DC (202) 331-7494.



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Nuclear Terrorism

THE Iraqi war has focused world attention on the combined threat posed by nuclear weapons and terrorism, a case where the whole is more fearsome than the sum of the parts. Having used chemical arms, Saddam Hussein might not balk at wielding atomic weapons. The anti-Iraq coalition has sought to prevent him from securing them by bombing reactors with weapon-grade fuel and plants to build centrifuges for enriching uranium. Unfortunately, bombing suspicious facilities will merely aggravate the nuclear threat; only diplomacy can resolve it.

The problem with bombing is that, even if Hussein is obliterated, others will follow in his footsteps. Those who are concerned about Iraq will not find it comforting to know that Libya and Iran are also thought to be seeking nuclear weapons, or that South Africa may already have them. The broad progress of technology will eventually allow any nation to join the nuclear club. It is easier to build almost anything today than 50 years ago, including the bomb.

A particular obstacle to stopping nuclear-weapon technology is that the peaceful atom is hard to isolate from the military atom. Centrifuges that enrich uranium for power plants can also enrich it for bombs. France and other nations are recycling fuel for power generation: they send spent fuel rods to plants that extract plutonium for reuse. The International Atomic Energy Agency may inspect some such plants under the aegis of the Non-Proliferation Treaty, but as Marvin Miller, an MIT nuclear engineer, wrote in *Technology Review* (August/September 1987), it is impossible to detect the theft of 1 percent of the plutonium—enough to make perhaps 20 bombs a year. If a nation or terrorist group stole plutonium or enriched uranium, thus securing weapon-grade material, “only modest machine-shop facilities that could be contracted for without arousing suspicion would

be required” to make the bomb, according to the congressional Office of Technology Assessment.

U.S. strategists seem hardly to have considered the political outlines of a world in which nuclear weapons are proliferating. This is not surprising since during the Cold War these strategists pushed ahead with developments such as multiple-warhead missiles without pausing to think how much more dangerous the world would be when the Soviets duplicated the technologies. Fortunately, the bomb itself helped keep the United States and Soviet

*Other ruthless
leaders may well achieve
Saddam Hussein's goal of
making the bomb. Then
what will we do?*

Union at a stand-off. Fears that any conflict could escalate to mutual destruction may have contributed to bringing both superpowers to the bargaining table.

If a small nation, particularly one with a ruthless leader, acquired the bomb, things might not work so evenhandedly. A few crude atomic weapons would put that leader nearly on par with the U.S. president. If the leader delivered an ultimatum and claimed to have smuggled a “suitcase” bomb into New York, what would the president do? Patriot missiles would be no consolation.

The growing ability to make nuclear weapons suggests that Third World conflicts could take three broad directions. First, diplomacy could settle conflicts before anyone resorts to nuclear terrorism. Second, some participants could acquire atomic weapons and bring others to the bargaining table with a nuclear gun at their heads. The third and most awful possibility needs no elaboration.

Bombing nuclear facilities is only

likely to exacerbate antagonisms that make the third possibility more likely. Besides, there are too many potential weapon states to attack, and the advanced nations will find it expedient to leave some of them alone, as was the case with Hussein before last August.

For all its difficulties, diplomacy is the only route. A start would be to strengthen the Non-Proliferation Treaty (NPT), which is due to expire in 1995. Despite loopholes, it provides a moral framework condemning the development of nuclear weapons. Many Third World nations want to strengthen the treaty but also want weapon states to stop nuclear testing, fulfilling the treaty's injunction to curtail their arsenals. The Soviet Union has agreed, but the Bush administration refuses. Its logic is hard to follow. Continued testing may make weapons more reliable, but we know they work well enough, and they must never be used anyway. Testing may also improve weapons' resistance to accidental explosion, but any minor gain pales beside the dangers if the rest of the world walks out of negotiations to curtail nuclear proliferation.

Congress should promote the NPT by refusing to authorize nuclear-weapon testing. In 1984, in response to a Soviet pledge not to test an anti-satellite weapon, Congress cut off funds for testing the U.S. counterpart, and both programs died. It was a significant victory for arms control. The House has similarly sought to prevent nuclear tests, but so far the Senate has restored funds.

Progress in superpower arms control came only hand-in-hand with improved diplomatic relations. Addressing nuclear-weapon proliferation will similarly require better relations between the industrialized North and the developing South, as well as among regional rivals in the Third World. The developed world could take positive action in this direction by working to redress extremes of wealth and poverty—extremes that have played a key role in the Iraq conflict as well as in others around the world.

JONATHAN SCHLEFER

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Letters



GLOBAL-WARMING DISPUTES

"How to Stop Global Warming" by José Goldemberg (*TR November/December 1990*) has a fatal flaw: it totally ignores nuclear power as a source of clean electricity.

Nuclear power plants in operation worldwide number more than 400, and in industrialized countries they provide from 20 to 80 percent of the electricity. In almost all cases, they replace fossil burning plants (mostly oil, some coal) without contributing to greenhouse gases in the atmosphere. I can only conclude that José Goldemberg is (a) ignorant about nuclear power or (b) so prejudiced against it that he cannot bear to suggest it as part of the solution to the global-warming problem.

CHARLES L. LARSON
Sunnyvale, Calif.

The author responds:

Nuclear energy can indeed replace coal, oil, and gas for electricity, but it does not replace fossil fuels used for any other purpose—for example, transportation or domestic and industrial needs. The truth is that electricity accounts for only about a third of the energy used in the world, and nuclear energy wouldn't even take care of all of that, although it might make a large dent in it.

Moreover, in developing countries, where most of the growth in consumption is occurring, electricity accounts for far less than a third of the energy used. Nuclear power will face many problems in these countries before it makes any significant contribution. This is even the case in industrial nations other than France and Japan—although not altogether for the same reasons. In the United States, for instance, nuclear power has come to a standstill.

HYPERTEXT HYPE

"Hypertext: The Smart Tool for Information Overload" by Robert Haavind (*TR November/December 1990*) leaves one critical issue unexamined: Who will be the hypertext authors?

Consider the following hierarchy: writing a novel, producing a dramatization of that novel for radio broadcast, and producing a movie version. Each step is harder, because each presumes the previous one and adds another level of complexity. Radio adds to the written word qualities like tempo and tone of voice and perhaps even background music. Film adds a world of color and shade, of figure and face. The sense of authorship also changes. A single author may write a book, but a movie, though it may have a single director, involves the talents of many actors, musicians, and others.

Hypertext documents are likewise complex—people predict that they will include images, music, voice, and animation. And every aspect of that complexity is sure to present a challenge. Take animation. I recently spent two months (and about \$50,000) producing a 200-second computer-animated videotape of a flight around the earth. Good animation is hard! Much harder than writing a textbook. Even drawing a good figure or taking a good photograph is hard.

Moreover, hypertext can supply many connections, but that doesn't compensate for the quality of any given one. A good textbook not only presents interesting morsels of information but orders them so that the reader can understand them and see the big picture. I believe that the best hypertext textbook will be much better than the best standard textbook on the same subject, yet I also believe that the worst will be far worse. Authors will need enormous concentration to work with the multi-dimensional hypertext lattice of relationships—and mountains of practice, too.

My greatest fear is that hypertext could consume so much time and so many resources as to restrict it to mass-produced works by the same dull, run-

by-committee publishers responsible for my high school textbooks.

WILLIAM MENKE
Tappan, N.Y.

LEAKS IN THE SCIENCE PIPELINE

I leaked out of the pipeline that Wade Roush talks about in "Science and Technology in the 101st Congress" (*TR November/December 1990*)—the one that "transmits scientifically adept young people from grade school to graduate school to careers." It didn't happen until after a two-year postdoctoral research associateship at Brookhaven National Laboratory. On the verge of a full-fledged career in academic science, I found there were simply no opportunities available here in these United States. I thus have been unable to make the contribution to society that might reasonably be expected of me, given the quarter-of-a-million-dollar investment my family and my Uncle Sam made in my training in high-energy theoretical physics. Instead, I am working as a consultant to an intellectual-property law firm.

Unfortunately for the future of American science, my experience is not an isolated one. Most, if not all, of my former colleagues are having the same kind of difficulties. One physicist I know, married and just barely still thirtysomething, is in his third postdoc and seriously considering a fourth poor-paying job that would last at most three years and offer no possibility for advancement or entry onto the fabled tenure track. A second physicist of my acquaintance, married with two children, has managed to find an assistant professorship at \$36,000 a year, but he has to pay nearly \$2,000 a month in rent in New York City—an impossibility without help from his wife's family. A third friend, a gifted young physicist whose work has won the approbation of Einstein's intellectual heirs at the Institute for Advanced Study in Princeton, languishes in his second postdoctoral holding pattern, trying valiantly to support his wife and two children in Boston on a grand total of \$23,000 a year.

Needless to say, he has to depend on continual support from his parents.

And this miserable condition is not limited to the abstruse and ethereal realm of high-energy theoretical physics. My friends in biomedical research tell similar horror stories. All these scientists work long, hard hours that would put any Wall Street greedhead to shame. There is a sardonic saying among them that "the extremely long hours are compensated by the extremely low pay." Is it any wonder that this country is falling behind other world powers technologically?

The federal programs described in Roush's article are steps in the right direction, but the leaks in the far end of the pipeline to science careers are nevertheless in serious need of repair. Doubling the federal government's budget for basic research and development would help.

RANDALL C. FURLONG
Boston, Mass.

DEFENSE WITH A DIFFERENCE

In "Setting a New Agenda for Global Arms Control" (*TR November/December 1990*), Randall Forsberg suggests that the world should take a new approach to defense. While this goal is not without merit, it doesn't stand a chance of being reached.

First, Forsberg is mistaken in saying that industrialized countries no longer want to influence the government or economic system of Third World nations by sending large numbers of young men to die in civil wars. What does she think is happening in the Persian Gulf? What about Nicaragua, Granada, Panama, and Libya? Didn't she ever listen to the Great Prevaricator expounding on the danger that Texas might be invaded if our "freedom fighters" failed to defeat the vassals of the Evil Empire? She might claim that the gulf action is in accord with a United Nations resolution, but the truth is that in dozens of cases the United States has been the only country—or one of the two or three countries—voting against

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MIT Reporter

WILL THE PUBLIC SAY YES TO NUKES?

 The gap between nuclear power advocates and critics is summed up in their differing views on the Three Mile Island accident. Opponents think the event exemplifies the failure of nuclear power in the United States because the reactor's core partially melted. Proponents think the accident affirms the safety of nuclear power plants because so little radioactivity was released.

The dormant industry won't revive unless the public reaches a consensus about the need and safety of this power source, according to Michael Golay, director of MIT's Program for Advanced Nuclear Studies. Without such agreement, he adds, it is likely that nothing will come of discussions about new "fail-safe" reactor designs and nuclear power's ability to supply energy without contributing to the greenhouse effect. With that viewpoint in mind, Golay has started a series of symposia to explore public attitudes toward nuclear power and to come up with ideas for making the technology more acceptable.

An international group of expert analysts and proponents from industry, government, and academia were the main participants at the first meeting. Only a few moderate critics attended, although Golay says he asked groups

skeptical of nuclear power to participate. However, the MIT program did not invite organizations that believe nuclear power should never be used.

This point was not missed by Peter Grinspoon, Greenpeace's national anti-nuclear campaigner. Speaking of the organizers, he says, "They say they want a consensus, but exclude the groups they really need to convince to get one."

Golay responds that including such organizations in future meetings would be useful only if the groups would consider that the technology might be made acceptable in the future.

A Lack of Trust

The speakers at the symposium acknowledged that a meeting of the minds about nuclear power might not be easy. University of Oregon psychology professor Paul Slovic pointed out that according to attitude surveys he has conducted, nuclear power inspires more fear than any other technology. Many perceive its hazards as the worst sort possible—involuntary, catastrophic, and fatal. The images nuclear power conjures up are so negative that people can't see any benefits from it, Slovic said.

Most members of the public don't really understand the risks of nuclear power, but experts' technical discussions of safe reactor designs may not

help, said Jan Beyea, a senior scientist with the National Audubon Society. "People judge the players, and won't believe the claims of nuclear power advocates once they have been proved wrong on a major point"—such as downplaying management problems at reactors.

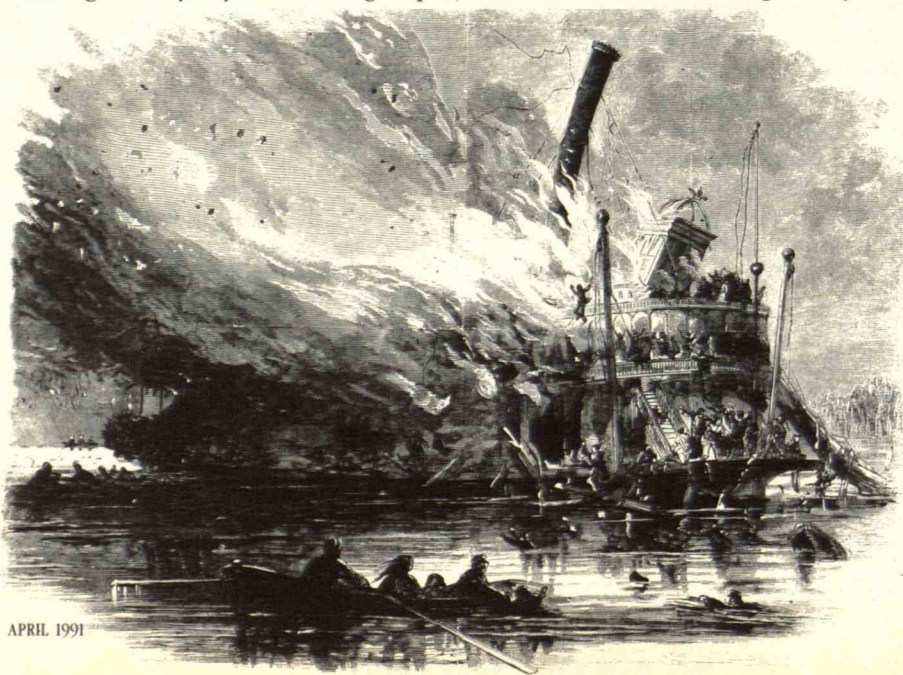
Lawrence Lidsky, an MIT nuclear engineering professor who has helped design one of the new fail-safe reactors, offered a radical way to demonstrate their safety mechanisms: by staging the worst accident possible. Engineers would drain the cooling water around the reactor core, put a "malicious operator" in charge, and pull out all the control rods, which capture neutrons and thereby stop the nuclear chain reaction. "The ability to withstand a worst-case, absolute test is a minimum requirement before nuclear power can play a significant role in the future," said Lidsky.

Acknowledging that such a test would likely never be authorized, Lidsky hinted that researchers could "sneak up" on one. They could withdraw the control rods a little way to find out how the system reacts, then repeat the action—assuming the system continued working safely—until they had pulled out the rods entirely. The cooling water could also be drained bit by bit, Lidsky suggested.

For now, the 110 working nuclear power plants in the United States *must* operate safely and efficiently, said Andrew Kadak, president of Yankee Atomic Electric Co. in Massachusetts. Radiation emissions, valve failures, and control-room mishaps only reinforce the nuclear industry's negative image.

Moreover, government and the industry must figure out how to dispose of radioactive waste safely, noted John

Michael Golay, director of MIT's Program for Advanced Nuclear Studies, says fears of nuclear power may not last. Steam boilers met with similarly stiff opposition in the 1800s, but despite explosions like the one on the steamer Magnolia, the technology improved and public attitudes turned around.





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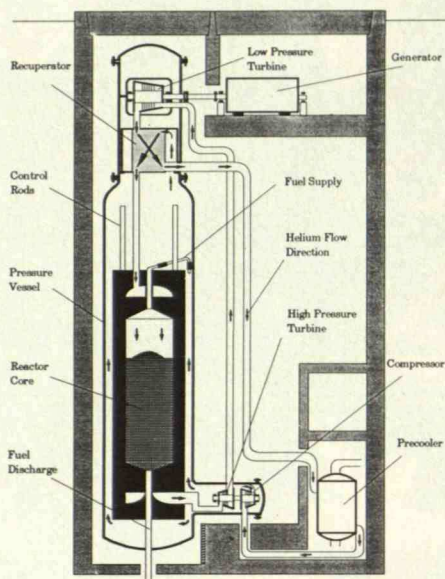
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"Fail-safe" nuclear reactors must be able to withstand worst-case tests, says Lawrence Lidsky, an MIT nuclear engineering professor who helped with the design above.

Ahearne, executive director of the scientific society Sigma Xi and a former Nuclear Regulatory Commissioner. In the public's mind, he said, nothing is more dangerous than nuclear waste.

The utility industry should take a hard look at renewable energy sources as well, said Robert Socolow, director of Princeton University's Center for Energy and Environmental Sciences. Socolow urged industry to fund research on renewables, which he believes are part of any energy solution.

The Nuclear Regulatory Commission (NRC) should also allow citizen input into reactor design and licensing at an early stage, according to Steven Sholly, a former analyst for the Union of Concerned Scientists who recently wrote a study for that group criticizing advanced reactor design. The NRC is now evaluating several new designs.

Slovic cautioned, however, that public skepticism might remain despite any stepped-up focus on nuclear power safety. Safety is a non-event that has little impact on public attitudes. Slovic went on to point out that reports of other technological problems—such as the *Challenger* explosion—have a "ripple effect," amplifying fears of nuclear power.

But Golay leaves the door open for critics and advocates of nuclear power to find common ground. He cites the historical example of steam boilers, which were introduced in the 1800s. People shied away from using steam energy at first since explosions kept killing people, but as stronger materials and better relief valves were developed for steam boilers, accident rates dropped and public resistance gradually turned around.—By P.J. SKERRETT, a free-lance science writer ■



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IMPROVING GROUNDWATER POLLUTION TESTS

 Two techniques used to sample groundwater beneath a former tannery in a Northeast state posed a dilemma: which to believe? One test showed chromium levels up to four times higher than the maximum allowed for drinking water. The other procedure, in which water was filtered to remove soil drawn up during pumping, did not detect the heavy metal, notes Robert Puls, an EPA soil chemist.

The truth may be that neither reading was valid. The best technique may be one that excludes relatively large soil particles while leaving in minuscule ones called colloids. Low-solubility contaminants such as heavy metals, PCBs, and some organic and radioactive chem-

icals can attach to colloids, which can be 10 times smaller than most bacteria. The groundwater can then sweep the containments along, according to research by Philip Gschwend, MIT associate professor of civil engineering.

The studies, which rely on pumping out water 100 times more slowly than usual, buck the long-held notion that only liquids—and hence only easily dissolvable contaminants—can seep into and pollute groundwater.

Other recent findings reinforce Gschwend's ideas. While working for the U.S. Department of Energy (DOE), analytical chemist William Penrose found trace amounts of plutonium and americium attached to colloids almost two miles from a Los Alamos National Laboratory site where the radioactive materials had been treated and disposed. The same elements did not stray



In groundwater downstream of a sewage infiltration site, Philip Gschwend, MIT associate professor of civil engineering, has found tiny particles like this one that can carry contamination.

at two other sites Penrose tested. He concludes that the unusual volcanic soil found at Los Alamos, N.M., played a



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role in creating contaminated colloids.

Gschwend thinks that the presence of colloids in groundwater results from a combination of soil conditions and water chemistry. Researchers at DOE, a sponsor of the work, believe Gschwend's soil studies could help rule out poor sites for radioactive waste disposal, says John McCarthy, a senior environmental scientist at DOE's Oak Ridge National Laboratory.

But studies don't yet indicate how much contaminated colloids contribute to groundwater pollution. "They could be contaminating groundwater much more than we thought," Gschwend says. "But it's also not proven that colloids are carrying a significant quantity of PCBs" and the like. The pollutants that attach to colloids may precipitate out of water onto large chunks of soil, he explains.

Despite that uncertainty, Baltimore Gas and Electric Co.—one of the energy utilities that have helped fund Gschwend's studies—will soon start to use the slower pumping method to assess groundwater pollution at the site of a former Baltimore factory. The utility is facing a \$10–40 million cleanup at the site, where gas was manufactured from coal in the days before natural gas was used. Coal tars were dumped from the mid-1800s until after World War II, says Herbert Hoffman, a Baltimore Gas senior engineer.

DOE may also try to determine whether it's possible to use colloids to remove contaminants from groundwater, according to McCarthy. One idea is to remove tiny particles. Another idea, in the case of clay colloids, is to amass them into underground walls that would act as filters.

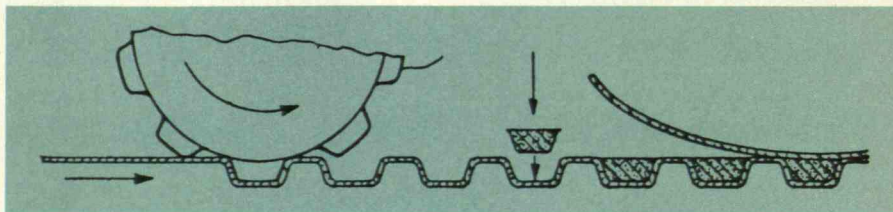
As for the former chrome tannery, EPA chemist Puls has sampled the groundwater beneath it using a slower-than-normal rate of pumping that he says picked up colloids and left soil particles behind. The tests did not show away trace of chromium, which means the site isn't quite as badly polluted as had been feared.—By LAURA VAN DAM, a Technology Review senior editor ■

INSULATING WITH GLASS

The Montreal Protocol, the 1987 agreement by the world's industrialized countries to protect the earth's vital ozone layer, started a race to develop environmentally friendly insulation. Conventional foams used to insulate buildings and refrigerators are 95 percent chlorofluorocarbons (CFCs), which scientists have implicated in depleting atmospheric ozone. Now Leon Glicksman, an MIT professor of thermal science and building technology, has developed an insulating panel that he says is not only environmentally safer but actually works three times better than today's products.

Looked at straight on, Glicksman's panel has a quarter-inch covering of a kind of foam that doesn't contain any CFC gases. Lacking CFCs, the foam cannot insulate. Instead, it serves as a protective cushion covering rows of rectangular, glass-walled chambers vacuum-packed with bricks of silica powder three to four inches wide.

Glicksman's technique calls for making depressions in a layer of glass, inserting silica, and then covering it all with a second layer of glass.



The glass is the key innovation. Other researchers have also developed insulating panels that combine vacuums—which halt much more air seepage than CFC foam panels—and silica, which blocks radiative heat loss, but these engineers have enclosed the silica with either plastics or metals. Metals lead to heat loss, since they conduct heat so well, while plastics age after a few years, enabling air to seep through them. Glass, however, conducts heat about 20



MIT professor Leon Glicksman has developed an insulating panel without ozone-depleting chemicals.

times less readily than metal. And air seepage is less of a problem with Glicksman's panels. They resist cracking under the stress of heat changes by being extremely flexible, measuring just 10 one-thousandths of an inch thick.

Glicksman says his insulating panel will last "indefinitely, and will prevent any air leakage over the lifetime of the appliance or building." Also, he points out, the panels have many chambers, which means that even if a few are broken during a sloppy installation job, the insulation won't be destroyed.

"Technology like [Glicksman's panel] is extraordinarily important" because of its improved insulating ability as well as its lack of CFCs, says Stephen Andersen of the division of global change at the U.S. Environmental Protection Agency. At a time when the world is worrying about global warming, improving energy efficiency is critical, he says.

Glicksman is talking to companies interested in producing his insulating panel, which he thinks could be less expensive to make than conventional foam board. Silica and glass are cheap, and production costs would not be prohibitive, he believes. Equipment for manufacturing glass cooking dishes could be modified to make the glass-enclosed chambers.—By LINI S. KADABA, a Philadelphia Inquirer reporter ■

Trends

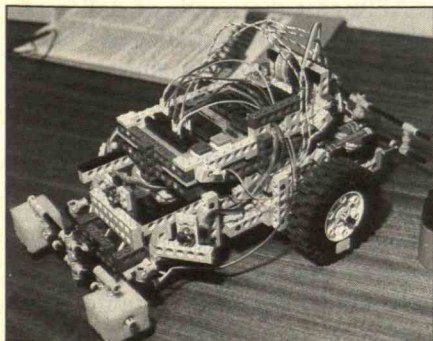
Is It Live Or Is It Memory?

Someday, a novel breed of life may declare 1987 Year One of its calendar. That was the year Christopher Langton gathered biologists, computer scientists, and a diverse set of other researchers at the First Artificial Life Workshop.

A computer scientist at Los Alamos National Laboratory, Langton calls himself the "midwife" of artificial life. In tinkering with computer programs designed to mimic evolution, he created systems "that exhibit behaviors characteristic of natural living systems." And after doing an extensive search for articles on related subjects, he discovered that other scientists were engaging in similar efforts.

Although artificial life is a broad and hazily defined concept, it is typified by a computer program consisting of random collections of data. These represent biological organisms, and the randomness simulates the molecular components of the primordial soup from which life arose. Algorithms—instructions—simulate evolutionary processes such as natural selection or mutation and manipulate the data. Some "organisms" adapt to their environment and reproduce. Others, obeying Darwin's dictum of survival of the fittest, fail.

University of Edinburgh researchers use Lego robots and artificial-life computer programs to study biological organisms.



To the surprise of many researchers, artificial life can behave in ways that aren't explicitly programmed. This "emergent behavior" arises because the creatures interact and influence one another's behavior. "Most of the interesting phenomena in living organisms are emergent in just this same sense—life emerges from the interactions of a great many nonliving molecules," Langton points out.

Although emergence can be studied by observing creatures that reside solely in a computer memory, some scientists use robots to get a better sense of what tactile, mobile beings experience. Jim Donnett of the University of Edinburgh enhances robots made from Lego kits to test his hypothesis that intelligence is one emergent property of life.

Each of Donnett's robots incorporates a directive prohibiting it from bumping into things. Donnett hopes to see whether the robots will avoid hitting one another as well as objects around them. This would shed light on their ability to form a cooperative population, an ability that he reasons would indicate intelligence.

In nature, emergent behavior, like life, evolves over millions of years; in a simulation, these processes may appear in a few days or less. That speed has been a godsend to University of Delaware evolutionary biologist Thomas Ray. He tries to synthesize life rather than simulate it, using computer-based creatures that already know how to replicate and evolve. Synthetic life particularly interests Ray because it should "evolve structures or processes that were not designed in or preconceived by the creator."

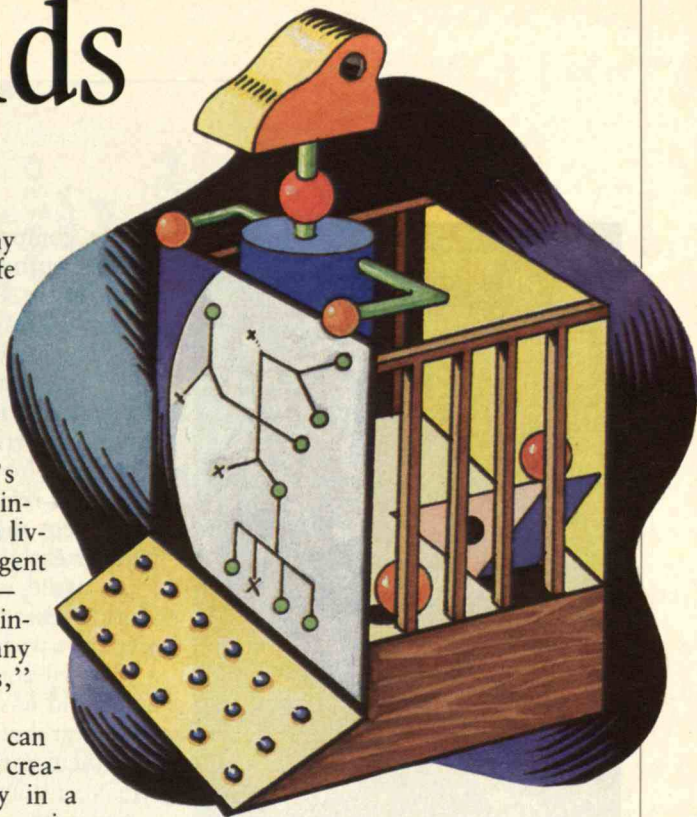
If this happens, it would provide a model of emergent behavior that Ray

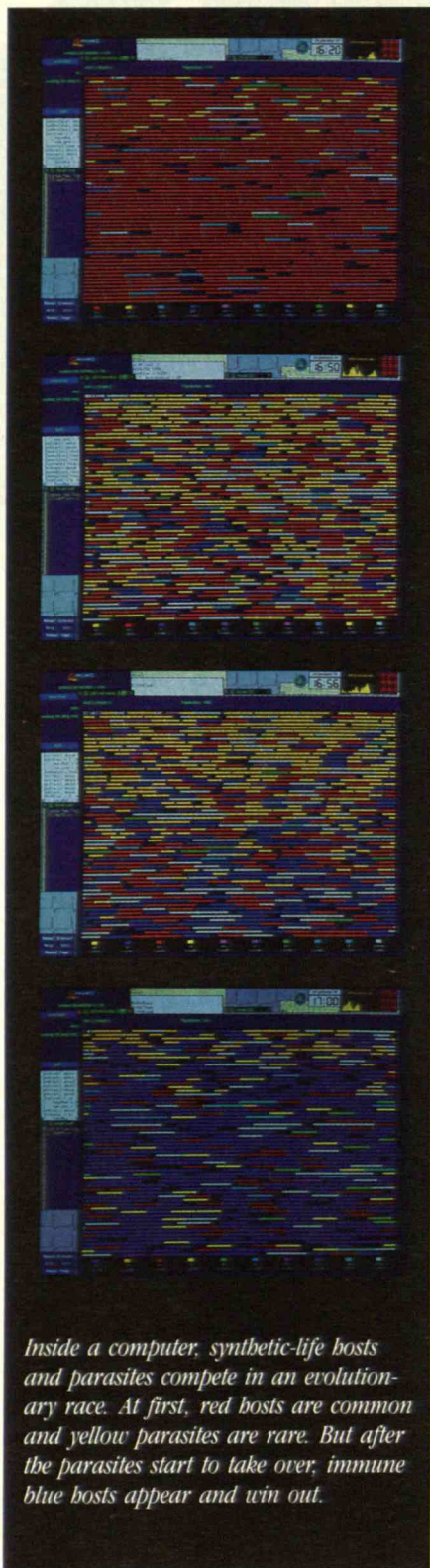
could observe well within a human lifetime. Presently, scientists can make only educated guesses at that behavior in a natural system because of the vast time spans involved. Ray would also be able to tweak the model, an ability obviously unavailable to evolutionary biologists otherwise.

Although Ray started out by modeling only a single organism, several different types developed in the first run of the program. One variety drove the rest to extinction by "stealing" their energy. Ray noticed that the survivors—he named them "hyper-parasites"—began to exhibit social behavior when they were the only type of organism left. Neither energy stealing nor social behavior were inherent in the system but "emerged spontaneously as the creatures discovered one another," says Ray.

Ray believes the reason for his first-time success at synthesizing life is that "life is such a powerful force. . . . If you just marginally set up the conditions for life to go, it will come out, and you will get evolution of all sorts of interesting phenomena."

But since artificial life can be prolific, how does a researcher ensure that these creations don't overrun the computers forming their world? For ex-





Inside a computer, synthetic-life hosts and parasites compete in an evolutionary race. At first, red hosts are common and yellow parasites are rare. But after the parasites start to take over, immune blue hosts appear and win out.

ample, computer viruses don't evolve but do reproduce, qualifying them as artificial life. These viruses can hog a system's memory and even damage programs and data.

Thus, Langton stresses, risk management should be uppermost in the minds of artificial-life researchers. Anyone who doesn't recognize the danger of releasing computer viruses, or prevent them from being released inadvertently, is being irresponsible.

To avoid interfering with the real world, researchers run artificial-life scenarios within programs that act as a "virtual computer." The artificial-life world has meaning in the virtual computer, but otherwise the creatures and their environment are harmless streams of data.

For instance, Thomas Ray runs his experiments on a simulator that can accommodate potential interactions among many different artificial organisms. The simulator is a set of algorithms that can "determine everything from the nature of the genetic code . . . to the structure of the ecological community," says Ray. In effect, it's a silicon biosphere complete with organisms. A "reaper" program kills those that don't adapt, removing them forever from the simulator's memory.

Langton takes ethical issues a giant step farther. Amidst the experimentation and hypothesizing, he says that artificial-life research may pose a moral question: do humans have the right to constrain the evolution of artificial life? Might this life outgrow the adjective artificial and acquire rights and privileges now enjoyed only by natural life?

Perhaps, says Langton. "We have to understand that whether we consider them 'alive' or not, we have set in motion autonomous, physical processes that we may never be able to control—or indeed even have the 'right' to control." ■

—SUSAN SCHECK, a free-lance writer living in Long Island, New York

Uncivil Suits

How does a polluter quiet disgruntled citizens? SLAPP them. Irene Mansfield of Pearland, Tex., was SLAPPED with a \$5 million lawsuit by the operator of a hazardous-waste landfill. A Culver, Ind., landfill operator SLAPPED Dixie Sefchek for opposing its unsafe practices.

SLAPPs—strategic lawsuits against political participation—are retaliatory civil suits aimed at chilling citizen activism on controversial issues. Usually hazardous-waste operators and developers file them, claiming injury from a citizen or community group that is trying to influence public policy.

SLAPPs are being used "to stifle political expression," charge attorney George Pring and sociologist Penelope Canan, both of the University of Denver. By studying the suits with a National Science Foundation grant, they found that thousands of citizens have been SLAPPED simply for exercising their constitutional rights. The First Amendment protects just what SLAPPs seek to stop—attempts to promote or discourage governmental action, including petitioning and writing public officials, reporting violations, filing complaints with government bodies, and testifying at public hearings.

According to Pring and Canan, "SLAPPs have their effect: many targets give up, many are chilled from political participation, and public interest campaigns die." Even losing SLAPPs cost thousands of dollars, in effect disempowering citizens. "This is big business's way to shut up local citizens from opposition," says Irene Mansfield.

Mansfield and her neighbors organized the Pearland Area Action Association to clean up their suburban Houston community. In particular, the association wanted to protect 220 wells fed by the Chico Aquifer from the Hill Sand Co.'s toxic-waste land-



filling and burning.

In July 1986, Hill Sand sued Mansfield for calling the landfill near her home a "dump." Her husband Radford, who had not protested the landfill, says he was also named in the suit because he failed "to control his wife."

"My first reaction was disbelief," recalls Irene Mansfield. "But the reality of a \$5 million suit made me angry and afraid that we would lose our livelihood."

After almost three years of depositions, court appearances, and thousands of dollars in attorneys fees, the SLAPP was dropped in May 1989. But the damage was done. Many members of the association had become scared and withdrawn support. Officers had resigned. Hill Sand Co. has since closed, and now EPA is investigating the landfill for designation as a Superfund site.

Dixie Sefchek was SLAPPED in 1987 along with three other leaders of Supporters To Oppose Pollution (STOP). Filed by Environmental Waste Control, the SLAPP claimed loss of income, defamation of character, and libel. It alleged that Sefchek lied by quoting state documents the company disputed.

"We could document everything we had said. We knew we hadn't done anything wrong, but we were really scared. It was pure intimidation of the normal everyday citizen," says Sefchek. "It's like a death threat to your organization. People, organizations, and churches stopped giving money. Individuals resigned their memberships." The suit was dismissed in 1988 for improper filing, and last year a judge ordered the Four County Landfill closed because the site was hundreds of times over permissible levels for groundwater contamination.

Attempting to stifle protests, an Indiana landfill operator sued Dixie Sefchek, the mother of two-year-old Kyle.

The Yahoos' Last Gasp

To defend themselves, some SLAPP victims go to the expense of filing their own lawsuits—SLAPPbacks. A Southern California agribusiness giant lost a SLAPPback to a group of farmers it had SLAPPED. The farmers won \$13.5 million in 1989.

However, in moving disputes from public and political forums to the judicial arena, SLAPPs tax overburdened courts with suits that are often dropped or dismissed. To discourage baseless suits, the Colorado Supreme Court recently developed a test that plaintiffs must meet when suing citizens who are trying to influence government decisions. Colorado courts will promptly dismiss a SLAPP unless the plaintiffs can show that the citizen actions lack any factual or legal basis, that they are intended mainly as har-

assment, and that they might hurt the plaintiff's legal interests.

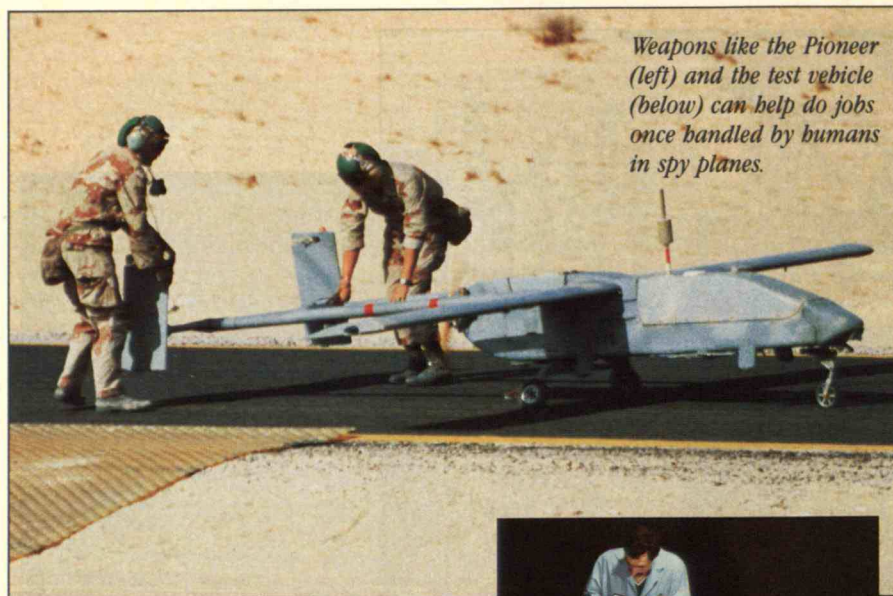
Taking another approach to stem SLAPPs, New York State is considering legislation to protect citizens and public officials from vengeful civil suits. In 1985, and again in 1990, New York attorney general Robert Abrams and two of his assistants were SLAPPED—for \$20 million—after they brought a cleanup suit against George Lawrence, operator of a chemical-processing facility in Nassau County.

Last October, the state's assistant attorney general Nancy Stearns told a judiciary committee that an anti-SLAPP law would signal "that citizen participation in the public process must be protected, and retaliatory lawsuits are not acceptable." The New York bill would provide costs, attorney's fees, and punitive damages for targets of SLAPPs, and it would encourage courts to dismiss SLAPP suits or expedite motions and summary judgments.

Fortunately, the SLAPP strategy may be on a natural decline, says Will Collette, organizing director of the Virginia-based Citizens Clearinghouse on Hazardous Waste. "SLAPPs are principally done by small-time operators on the verge of losing," he says. "It's a last-gasp measure by these yahoos."

Collette also believes that publicity can stop SLAPPs from being filed. Thus, he advises citizens groups to "hold a rally at the county courthouse or war memorial. Have American flags, moms and babies, and members of the clergy. Talk about American values of free speech." ■

—TOBI LIPPIN, a free-lance writer in Durham, N.C.



Weapons like the Pioneer (left) and the test vehicle (below) can help do jobs once handled by humans in spy planes.



Unmanned Flying Vehicles

On the electronic battlefield, a 70-year-old low technology might save money and pilots' lives. "Unmanned flying vehicles" (UAVs) carry non-nuclear warheads or, more often, reconnaissance equipment. Says Col. Lawrence Karch, Marine Corps director of UAV testing and evaluation, "They're good at the three Ds—jobs that are too dull, dirty, or dangerous for pilots."

The United States has two types of UAV, which have been around since World War I. One is the preprogrammed UAV, which flies to a destination and returns to its base. With the second type, remotely piloted vehicles (RPVs), a pilot on the ground handles the controls. It's much like flying a model airplane, and, in fact, some UAVs are little bigger than toys.

"A lot of our blues over risking pilots and expensive planes tailored to them could be solved by UAVs," maintains Richard Fieldhouse, senior researcher at the Natural Resources Defense Council (NRDC). Kosta Tsipis, an arms control expert at MIT, points out that "if you lose one UAV, you don't lose much. You don't have to buy a new plane and train another pilot."

The United States got into modern UAVs in the early 1960s after the So-

viet Union shot down a U-2 spy plane and handed Washington a public relations disaster by capturing the pilot, Gary Powers. Since then, one role for UAVs has been in what the Pentagon calls "mid-intensity conflicts" in Vietnam and the Middle East.

In Vietnam, the Air Force's Lightning Bug UAVs were particularly successful at taking detailed photos in dangerous areas or those where, as in the U-2 case, it couldn't afford to have its spying revealed. Lightning Bugs helped U.S. forces assess damage after bombing raids, find prisoner-of-war camps, and locate targets in Vietnam and probably in the secret, illegal war in Laos as well.

However, the Air Force lost interest in UAVs. In 1973, it put reconnaissance UAVs, which had flown to North Vietnam and China, into storage, writes Joseph Lovece in *Armed Forces Journal International*. He notes that a project to replace the U-2 with a UAV was canceled in 1977 in favor of piloted aircraft when military budgets tightened.

Tsipis remembers a mid-1970s Air

Force study that found UAVs could handle several of pilots' main missions more effectively and cheaply, including reconnaissance and hitting targets deep behind the lines. But, says Tsipis, the Air Force suppressed the study lest it upset plans for expensive, high-tech piloted weapons.

At the same time, Israel "figure[d] out how to use UAVs well," Fieldhouse remarks. During the 1973 Yom Kippur War, Egyptian forces wasted missiles on UAVs instead of Israeli fighter planes; in 1982, RPVs ferreted out Syrian radar and missile sites in Lebanon's Bekaa Valley.

With a single fighter plane costing over \$100 million, UAVs attracted U.S. interest again even before the Persian Gulf war—particularly among members of Congress and military contractors who thought they had a cheap, effective weapon. Within the Pentagon, the Defense Advanced Research Projects Agency has funded several classified UAV programs since the early 1980s. In 1988, Congress required the Pentagon to set up a joint service program for UAV development, with a FY 1991 budget of \$122.4 million.

No Buyers at \$25,000 each

The Defense Department as a whole, however, appears to be less than enthusiastic about UAVs, and DARPA says it has no UAV projects under way now. "The services would always tell me that UAVs looked promising—in the future," says Tony Battista, an influential former staffer of the House Armed Services Committee. "They'd take a simple concept through research and development. Then, when it was ready for producing, it would somehow disappear."

Battista believes the problem is that the Pentagon doesn't want simple—and cheap—UAVs. From 1974 to 1987, the Army spent \$1.8 billion on Aquila, a high-tech UAV for a host of tricky missions—flying in bad weather, escaping detection, waging

electronic warfare, finding targets, taking reconnaissance photos. The Army finally killed the costly project, a step Battista had recommended.

By contrast, recalls Air Force technical analyst Tom Amlie, in 1987 the Navy commissioned a world champion model-plane builder to design a reconnaissance RPV. "Maynard Hill came up with a little plane with an eight-foot wingspan," says Amlie. "It carried a color TV camera, had a range of 20 miles, and couldn't be jammed or detected. The total R&D budget was \$100,000."

The reaction was tepid at best. According to Amlie, "No service wanted a UAV that would have cost perhaps \$25,000 apiece."

At the same time, the stock of UAVs seems to have been rising as the Pentagon readied itself to initiate a mid-intensity conflict. Hampshire College arms analyst Michael Klare thinks UAVs are tailor-made for the Mideast war, where the U.S. military is fighting against a Third World power equipped with modern anti-aircraft defenses. "In a place like Iraq," Klare adds, "UAVs are especially important for reconnaissance because we weren't prepared to fight there. In Eastern Europe, we probably know the whereabouts of every ditch and tree stump."

For the war against Iraq, the Army and Marine Corps have the battery-powered Pointer, which soldiers carry in two backpacks. It travels about three miles and sends back reconnaissance photos. The Army, Navy, and Marine Corps use an Israeli-designed RPV, the Pioneer, to support artillery by finding targets. The Pioneer can fly 130 miles and land on a road runway, or battleship.

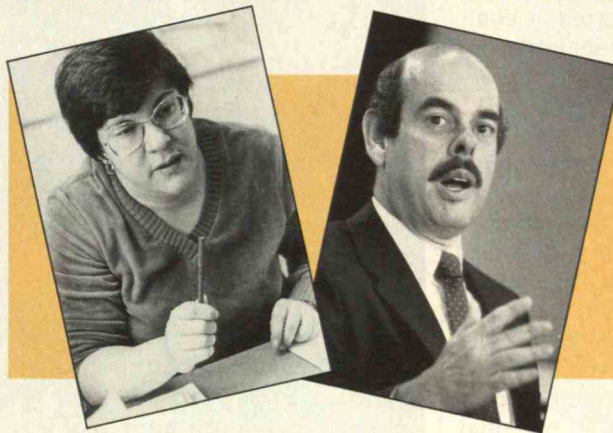
Nevertheless, the NRDC's Fieldhouse insists that the Pentagon continues to oppose a big UAV program. "But call me in two months after we lose 50 aircraft in Iraq." ■

—ANN MARIE CUNNINGHAM, a Technology Review contributing writer

Spoiled By Success?

A number of small biotechnology companies and patient advocates want Congress to reform a law that even they say has led to new drugs for rare diseases. These critics charge that a few firms have exploited the Orphan Drug Act to gain exclusive markets and whopping profits—at great cost to consumers.

Because drug R&D costs are high—averaging \$100 million—pharmaceutical companies had regarded treatments for rare diseases as a poor investment. Thus, to stimulate research into drugs for such diseases, Congress enacted the Orphan Drug Act in 1983.



Abbey Meyers of the National Association for Rare Disorders agrees with Rep. Henry Waxman that his 1983 Orphan Drug Act is great—and needs fixing

The legislation gives tax breaks and, in some cases, grants to firms investigating drugs for diseases that afflict 200,000 or fewer Americans. More importantly, it awards a seven-year monopoly on orphan therapeutics that win Food and Drug Administration (FDA) approval. Also, FDA often gives orphan drugs "fast track" approval, since the agency seeks to move quickly when no therapy exists or existing ones are inadequate.

"The problem is that a small number of companies have abused the intent of the law," says Abbey Meyers, executive director of the National Organization for Rare Disorders (NORD), based in Fairfield, Conn. In

particular, she cites human growth hormone (hGH) and erythropoietin (EPO). According to Meyers, both are commercially viable without any special incentive.

Even before 1983, five companies had been working on hGH to treat pituitary growth hormone deficiency. Under the Orphan Drug Act, FDA certified hGH versions manufactured by Genentech and Eli Lilly, dividing the market between the firms. (FDA granted dual approval because the side effects of the two drugs differed considerably.)

"This is clearly not an orphan drug," says Tom Wiggins, president of Serono Laboratories, whose own hGH is excluded from the U.S. market. Even though hGH fulfills the

200,000-person criterion, he estimates that sales amount to \$150 million a year, and the total revenues for a seven-year monopoly could exceed a billion dollars. Moreover, says Wiggins, the Genentech/Eli Lilly monopoly is hardly in the public interest, since hGH costs patients \$10,000 to \$30,000 a year.

EPO's potential sales are as large. Amgen manufactures the drug, which FDA has approved for people suffering chronic renal failure. But Genetics Institute is also developing EPO and insists it is not properly an orphan drug. A Genetics Institute spokesperson points out that EPO might help people with any of a number of dis-

eases, including an anemia associated with AIDS therapy. Together, these add up to far more than 200,000 people. But, she charges, Amgen sliced the market into sub-categories to win orphan-drug status based on the incidence of just one disease.

Amgen—and FDA—say otherwise. The California firm proved EPO can treat renal failure, but other benefits are less clear. Amgen spokesperson Mark Brand adds that anyone is free to “go out and invest in any other area for EPO.”

These two orphans are not unique. FDA also designates all AIDS drugs as orphans. One drug, aerosolized pentamidine for an AIDS-related lung condition, already enjoys an exclusive market, although AIDS patients would like FDA to approve a competing product using an inhalation device, which they say is more convenient to use.

Share and Share Alike?

Even the voices calling for reform—which include Rep. Henry Waxman (D-Calif.), sponsor of the 1983 law—point out that the Orphan Drug Act has done its job well on the whole. FDA has approved 53 orphan drugs, including 11 genetically engineered products, with another 410 potential medicines in testing. Thus, NORD's Meyers and others suggest specific revisions are needed, lest legislators react to blockbuster profits by gutting an otherwise valuable act.

For example, basing orphan status solely on the incidence of a disease subsidizes drugs like hGH and EPO that would be profitable in a competitive market. Meyers suggests that exclusivity should end once a company has earned a reasonable profit. As companies approach the specified limit, they would likely lower the price to protect the monopoly as long as possible.

However, Richard Godown, president of the Industrial Biotechnology Association, whose organization



Drug companies insist that the cost of developing new products justifies high prices to consumers.

counts several large companies among its members, calls profit caps “a veiled attempt at price fixing.” They would lead firms to “massively turn away from orphan drugs,” he says.

In fact, Wiggins agrees that a “profit cap would be very difficult to manage,” saying the high price of some drugs is justified by the limited market. Thus, he opposes caps and can’t promise that FDA approval of Serono’s hGH would drive prices down. He argues that what is needed is a better definition of an orphan drug. “The real problem is uncertainty. What is an orphan drug? The answer is problematic.” But, he says, a drug with a billion-dollar market shouldn’t qualify.

Pamela Bridgen, executive director of the Association of Biotechnology Companies, which tends to represent smaller firms, adds that reform is needed to create fair competition. Small companies laboring on a potential hGH or EPO may find themselves racing against pharmaceutical giants that can throw more resources into R&D and have greater experience with clinical trials and FDA reviews. “That could put the small company out of business,” she says. Godown and Bridgen agree on what he calls a “fair compromise”: shared exclusivity on the handful of orphan drugs that more than one firm is developing.

With the two industry associations agreeing on many points, Congress approved a Waxman amendment last year to allow companies to share the market. The amendment also called on the Department of Health and Human Services to create an Office of Orphan Disease to coordinate orphan-drug activities within all federal agencies.

However, President Bush surprised almost everyone and pocket-vetoed the popular bill. Waxman intends to introduce a revised version this session that might include profit caps. ■

—TOM KIELY, a Technology Review contributing writer

Prediction and Prevention

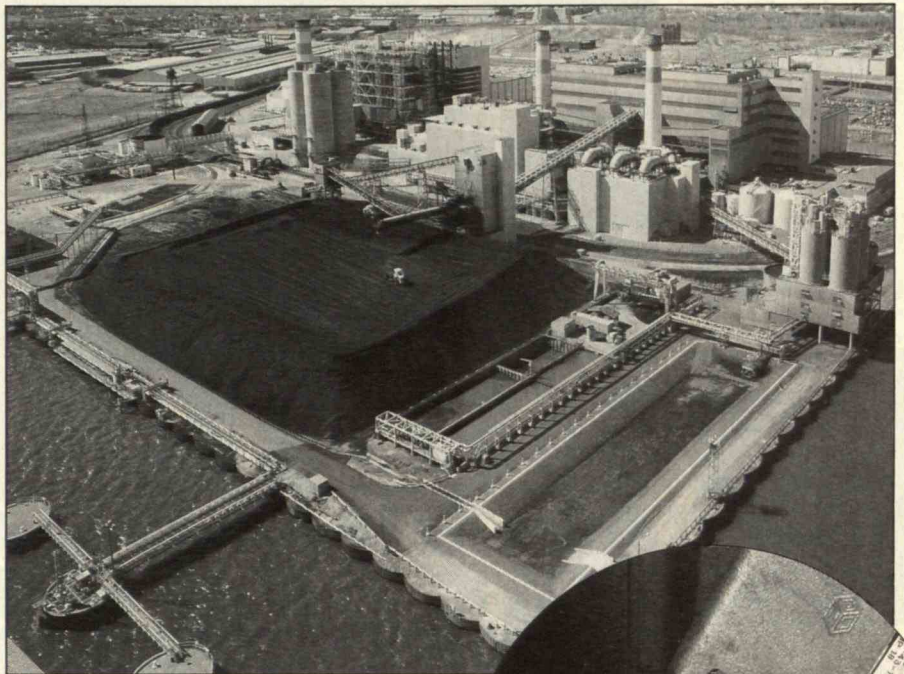
Within a decade, 80 percent of U.S. fossil-fuel power plants will be over 20 years old, and more than half will be over 30. Old age is normally time to retire, but the hurdles to building new plants are leading utilities to seek ways to extend the life of aging facilities.

The cumulative impacts of erosion, corrosion, and fatigue of old units can be considerable, and reliability rests on detecting failures before they happen. Preventing serious damage may depend on computer data-crunching and sensors that work in hostile conditions. Together such measures could allow utilities to diagnose almost all the degenerative problems that cause breakdowns.

The test bed is the Philadelphia Electric Company (PECo) Eddystone Station Unit 2. There, in 1987, the Electric Power Research Institute (EPRI), the utility industry's research arm, decided to explore the potential of monitoring technologies and initiated the Monitoring and Diagnostic (M&D) Center. With virtually every major component—boilers, turbine generators, and so on—permanently wired with sensors and connected via a "data highway," Eddystone engineers can observe, as they happen, the performance and wear of critical parts.

Moreover, although Eddystone is coal-fired, the electric utility industry as a whole will benefit from the efforts of the M&D Center. According to EPRI site manager Richard Colsher, "The diagnostic systems that we're installing are applicable to nuclear plants, oil-fired plants, and gas-fired plants."

In particular, the Eddystone project is exploring predictive maintenance, the idea that monitors can say exactly when equipment needs to be repaired. By contrast, utilities now rely on preventive and corrective maintenance.

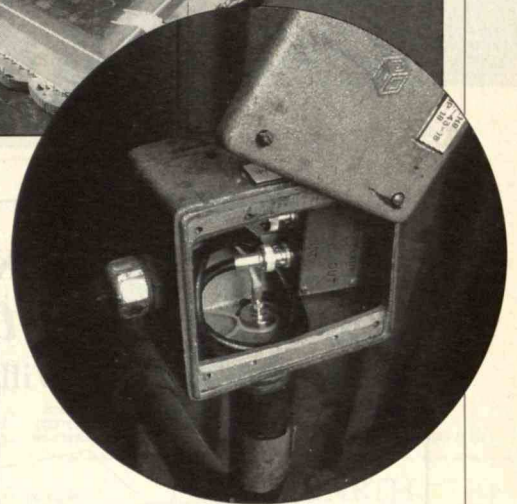


Tests at a Philadelphia power plant could help utilities safely extend the life of old facilities. This acoustic sensor bears even tiny boiler leaks.

Preventive maintenance, the dominant approach, entails inspecting and replacing parts on a regular schedule, often sooner than really needed. Though this helps reduce risks, replacement intervals are not well known for old plants. Also, preventive maintenance doesn't reveal when just-installed equipment would fail prematurely. Corrective maintenance, which means replacing only failed parts, is appropriate only for non-critical equipment, since a minor failure can bloom into a catastrophe.

Even before the Eddystone project began, a 1983 EPRI study suggested the price tag for each approach. The study indicated that corrective maintenance cost about \$17–18 a year per horsepower, while preventive cost \$11–13. The price for predictive maintenance was only \$7–9.

However, the full benefits of predictive maintenance, especially on the



scale at Eddystone, are yet to be accurately documented. Little data exists on which diagnostic monitors would provide real savings for plant owners. Thus, the center is compiling cost-benefit data. "Equipment monitoring is not enough," Colsher says. For a successful predictive-maintenance program, "you also need maintenance and operation histories, coupled with cost-benefit analysis."

Because predictive maintenance is relatively new, the M&D Center is field-hardening various technologies, and the extent of monitoring makes Eddystone a thorough test. In all, the project has installed over 30 diagnostic systems and is merging that effort

into the plant's regular maintenance program.

The Diagnostic Highway

Already, the diagnostic monitors tested in several areas at the M&D Center are ready for installation at other power plants. For example, one set of monitors detects boiler leaks, which result in 5,000 forced shut-downs in the United States each year. Applying work pioneered in Europe, Eddystone's acoustic leak detectors pick up the sound of expanding steam as it escapes through even the smallest hole. Sensors can listen as a pin-hole leak develops and grows, giving an advance warning for maintenance that ranges from a few hours to days. The Italian National Electricity Authority instituted a similar technology in the

1970s, as did Britain.

Power plants also tend to be plagued by vibrations in rotating equipment. That problem accounts for 30 percent of the forced shut-downs at fossil-fuel facilities. Cracking from vibrations, which can damage turbines and pumps, especially concerns utilities, since it is potentially catastrophic and extremely hard to detect. Eddystone's sensors, based on dedicated microprocessors that reveal a developing crack almost instantaneously, provide a highly detailed record to identify and evaluate potential failures. For example, Unit 2's main steam turbine has a multi-purpose vibration monitor, including a computer program to target cracks in rotors.

However, the wealth of data that so many monitors produce, coupled with

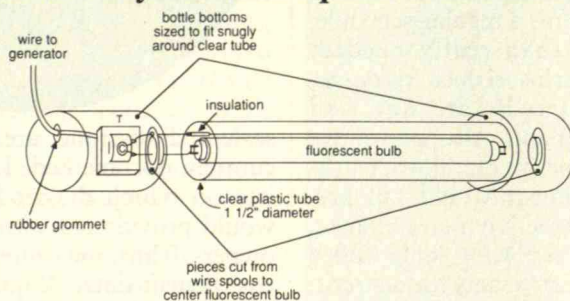
the diversity of faults, equipment, and processes, can present a problem to predictive-maintenance engineers. Thus, EPRI is investigating expert computer systems to systematically help plant personnel analyze the myriad mix of deviations.

Such systems become more precise as additional data accumulate. "The diagnostic monitor of the future will first flag an anomaly and then gradually refine the diagnostics," explains Anthony Armor, senior program manager in EPRI's Generation and Storage Division. Eventually, computers will tell operators when the accumulating danger signs are strong enough to demand taking corrective action. ■

—JEROME ROSEN, a free-lance writer in science and technology

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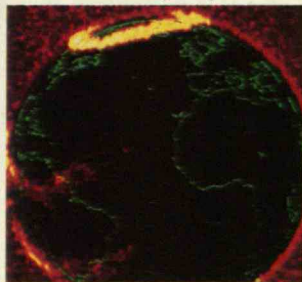
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LIFE AFTER GATT:

More Trade Is Better Than Free Trade

BY CLYDE PRESTOWITZ

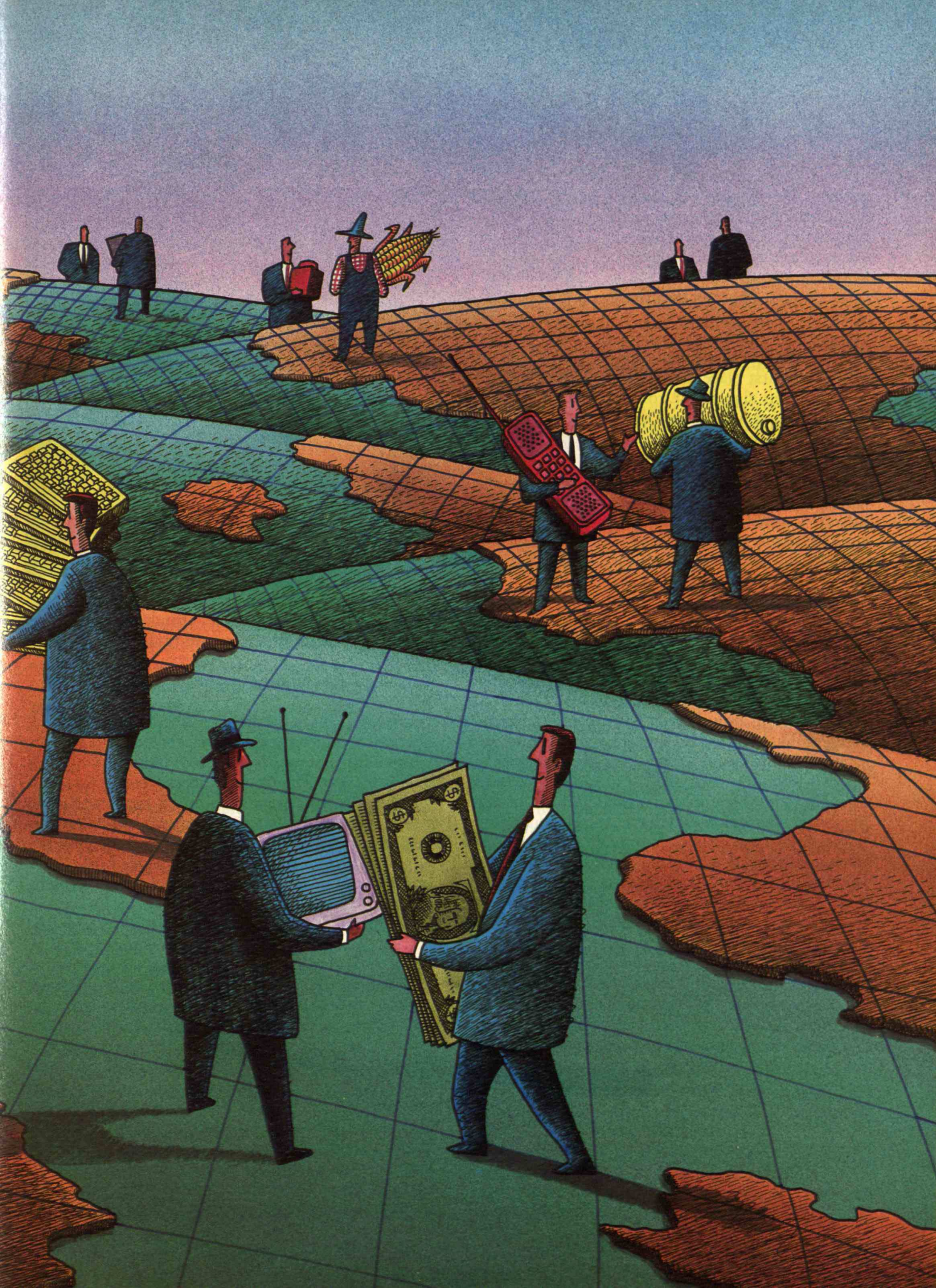
*The postwar trading system
is breaking down as its basic assumptions
about free trade prove inadequate. A more
realistic approach would help both U.S.
industry and the world economy.*

WHEN the recent round of world trade talks ended in a U.S. walkout last December, headlines proclaimed a crisis of the global economy. U.S. representative Carla Hills had argued for months that failure of the Uruguay round of the General Agreement on Tariffs and Trade, or GATT—the foundation for international trade since 1948—could lead to rampant protectionism, economic warfare, and global depression.

The immediate issue was U.S. insistence, roundly rejected, that European and other countries largely eliminate their subsidies to local farmers over a period of 10 years. The United States had also pushed for extending GATT rules, which regulate trade in manufactured goods, to service industries such as banking and shipping. U.S. negotiators further argued for strengthening protection of intellectual property, continuing to reduce tariffs, improving mechanisms for settling disputes, and setting up new rules to regulate foreign in

ILLUSTRATION: DAVID CHEN



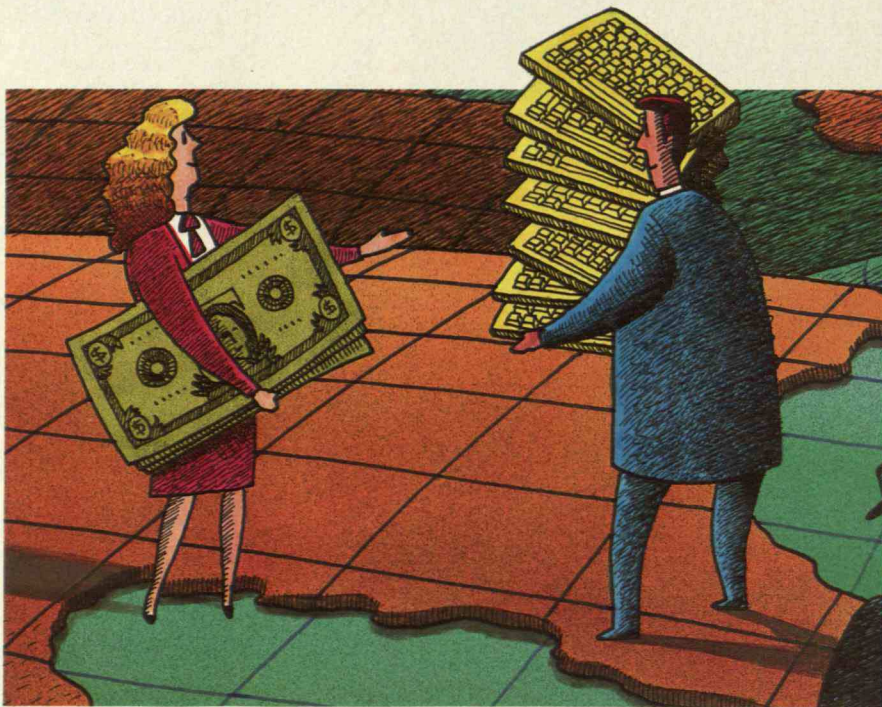


vestment. Negotiators working frantically behind the scenes may yet devise compromises that will likely be heralded as essential to pulling the world back from the brink.

But, in fact, whatever they finally agree on will not really matter. The Uruguay round was never likely to cure the ills of the world trading system. In the first place, few nations would obtain significant concrete benefits. According to the Department of Agriculture's own econometric model, the net U.S. gain in the unlikely event that other nations agreed to eliminate all agricultural subsidies would be only \$3 billion annually. Australia, New Zealand, Canada, and some developing countries would gain more. But the European Community (EC), Japan, and South Korea could count on substantial loss of agricultural jobs, and resulting political pain, if they moved to completely eliminate farm supports.

The United States could reap about \$14 billion annually from wide recognition of its patents and copyrights, but only if such rules were enforced—a highly unlikely prospect. And the United States, Europe, and Japan could not expect great incremental benefits from applying GATT rules to service industries. Developing countries, for their part, could suffer significant reverses in their efforts to develop indigenous service industries. It is even possible that the United States might post no overall economic gain—and could see a significant loss—if the talks succeed: many countries have demanded that it weaken its anti-dumping and other laws that aim to prevent unfair trade in return for concessions on agriculture and services.

Beyond the question of immediate gains, however, is a much more important issue. The world trading system is eroding, as the spiraling number of trade disputes and the drift toward regional trading blocs attest. Unfortunately, the agenda of the Uruguay round was never aimed at the underlying causes of this crisis. Instead it merely attempted to apply the failing GATT doctrine



even more broadly. That such an agenda is the centerpiece of U.S. policy points to a fundamental misperception of the realities of world trade.

Pursuing Comparative Advantage

Founded in 1948 at the dawn of American postwar economic dominance, the GATT was rooted in the Atlantic Charter discussions between Roosevelt and Churchill during the war. The United States agreed to reduce its traditionally high across-the-board tariffs if Britain would relax its practice of "imperial preference"—favoring trade with countries within the Commonwealth. The two countries further agreed to include other "like-minded" countries under the auspices of the charter.

Implicit in this agreement was the basic notion that markets free of regulation, and trade unrestricted by tariffs and other barriers, would raise the standard of living of everyone. Domestically that meant enforcing antitrust and other measures aimed at driving the economy toward perfectly competitive markets. Internationally it meant adhering to the "comparative advantage" concepts of David Ricardo and Adam Smith, who held that nations are best-suited to making some products rather than others because of climate, natural resources, population, and location. Ricardo's classic example was England, which applied its cold, rainy climate to raising sheep and making textiles while trading with Portugal for the wine produced in its warm, dry climate. Ricardo and Smith held that if each nation concentrated

CLYDE PRESTOWITZ directs the Economic Strategy Institute in Washington, D.C. From 1983 to 1986 he was the principal adviser on Japanese affairs to the U.S. secretary of commerce. He is the author of Trading Places: How We Allowed Japan to Take the Lead (Basic Books, 1988).

Because the United States no longer dominates the world's economy, its ability to use new GATT rounds to generate trade growth is limited.

on what it produced best, everyone would gain wealth from the growing volume of world trade.

The provisions of the Atlantic Charter led to the 1948 establishment of the GATT, along with the International Monetary Fund and the World Bank, as part of the U.S. and European effort to reconstruct the postwar economy. The key concepts of the GATT were "national treatment," which stipulated that countries must treat foreign participants in their economies the same as domestic firms, and "most-favored nation,"

under which GATT members agreed to extend to all their trading partners concessions awarded to one.

Proponents of this framework thought the only real problem for the trading system would be tariffs and other "border" measures that hindered the free flow of goods. The entire thrust of U.S. postwar trade policy therefore aimed to persuade nations to join the GATT and reduce tariffs. The United States generally took the lead in the various "rounds" of trade talks held every few years by offering concessions and giving more than it got. No matter, laissez-faire traders thought: the U.S. economy is so dominant that no other country will touch it. Moreover, even if other countries burdened their own consumers with trade restrictions, the United States did not have to imitate such stupidity. Finally, laissez-faire trade was thought to promote not only overall economic welfare but peace regardless of concrete benefits to the United States.

The rapid growth in world trade and living standards during the first postwar decades seemed to confirm that the system worked. This conclusion led to growing enthusiasm and pressure for further rounds of talks and broader agreements. The U.S. solution for every trade dispute became a GATT round. To entice countries into the Western camp, offer them a round. To combat world economic recession, do a round.

Trade frictions first became evident in the 1960s as textiles from Asia began to flood U.S. markets. Tensions accelerated in the 1970s when Japan and the other Asian "tigers" sold more and more televisions, autos, and semiconductors to U.S. buyers. Despite the U.S.

commitment to the theory of unilateral free trade, the United States began accusing those countries of not "playing by the rules" because they sold goods below cost in the U.S. market and targeted industries for expansion. After much recrimination, negotiators usually decided to evade GATT guidelines with measures such as voluntary export restraints on Japanese cars. This allowed the United States to claim it was a free trader while it actually engaged in sleight-of-hand protectionism.

The distortions, guilt, and gradual erosion of the system caused by continuing frictions and piecemeal solutions led to the Tokyo round, concluded in 1979. This was an ambitious attempt to apply GATT rules more thoroughly and open new areas such as government buying to international competition. Expectations were high. Special trade representative Robert Strauss predicted that access to \$25 billion of foreign-government orders would create up to 100,000 U.S. jobs, and U.S. negotiators agreed to relax anti-dumping rules to get the deal. The Department of Labor forecast that employment in the U.S. computer and semiconductor industries would rise 3–4 percent.

It never happened. U.S. electronics companies rapidly lost customers as foreign companies dropped prices to win a foothold in the U.S. market. U.S. firms gained virtually no contracts abroad from the new government-procurement rules, and trade disputes with Japan and the tigers multiplied faster than ever in areas such as machine tools, autos, semiconductors, and fiber optics. The inevitable response was the Uruguay round, which once again attempted to revitalize the world trade system by applying all the old rules even more broadly.

Potato Chips vs. Semiconductor Chips

U.S. negotiators need to do a reality check on their long-held assumptions. That trade grew and living standards rose during the postwar era does not prove cause and effect. Early GATT tariff-cutting no doubt stimulated trade, but the effects of advancing technology, better communications, and plummeting transportation costs have also been enormous. And trade has mushroomed within Europe largely because of the Common Market, which operates as a recognized exception to standard GATT rules stipulating equal treatment for all countries.

Most important, trade, which implies a two-way street, is not the best way to characterize most of the economic growth in the Pacific rim. The United States unilaterally opened its markets to those nations, who

had formal or de facto exclusions from GATT or, the case of Japan, because of U.S. reluctance to antagonize an important military and political ally. Thus the key was not so much GATT guidelines as the willingness of the United States to be the engine of growth and the flywheel on the system.

Today the United States does not hold the dominant economic position it did in 1950, and its ability to use new GATT rounds to generate trade growth is therefore limited. But an even more fundamental problem is that Japan, Korea, and many European countries do not subscribe to Anglo-Saxon notions of open markets and free trade. These countries contend that trade is intimately linked to national power, and they try to create comparative advantage in key markets.

The United States, in contrast, maintains that it doesn't matter what we produce so long as we produce a lot of it. This view was best articulated recently by Michael Boskin, chair of the Council of Economic Advisers, who said: "Potato chips, semiconductor chips, what is the difference? They are all chips. A hundred dollars worth of one or a hundred dollars worth of the other is still a hundred dollars." Boskin was only following in the footsteps of budget director Richard Darman, who at the height of the Japanese dumping of semiconductors in 1985 said: "Why do we want a semiconductor industry? What's wrong with dumping? It is a gift to chip users because they get cheap chips. If our guys can't hack it, let them go."

Few countries accept this thinking. Most have national policies aimed at moving their industrial base to higher levels of technology and value added. Thus the Europeans subsidize the Airbus and the Japanese target supercomputers, optical fibers, and biotechnology. Moreover, the truth is that when the chips are down (no pun intended), the United States does not really accept the "natural comparative advantage" doctrine either. For when the U.S. semiconductor and other major industries begin to falter in the face of unequal foreign competition, the result is usually trade friction capped by a deal that gives some kind of relief, half-hearted and inadequate, to the U.S. industry. This is what occurred in 1986, when Japan agreed to end its dumping of semiconductor chips and open 20 percent of the Japanese market to U.S.-made chips.

What happens when one country promotes cartels and another breaks them up, when one government practices bureaucratic intervention and industrial targeting while another refrains, and when one country has a highly developed sense of individual and corporate rights while another has no such concepts? Firms

from the less liberal countries will penetrate the markets of the more liberal countries but the reverse will not occur. Although this will be "fair" under the GATT system, countries with the most open economies will not believe it, and charges and countercharges will provoke rising trade frictions.

Moreover, although the GATT requires countries that negotiate concessions with each other to automatically extend the same deal to all trading partners, those partners are under no obligation to make any concessions in return. Countries less enthusiastic about free trade and open markets can therefore hold back while pocketing the offers of the true believers.

Thus the core principles of GATT discriminate against societies with the most open economies—ironically, the system's biggest supporters. While this has always been the case, the problem was hidden in the early postwar period by U.S. economic dominance as well as by the greater like-mindedness among the relatively few GATT members. But as membership has expanded and U.S. power has waned, this inherent flaw—not inadequate rules—has been the primary cause of growing tensions.

The United States did attempt to deal with this flaw during the late stages of the Uruguay round. It announced that it would not apply most-favored-nation provisions to telecommunications because countries with monopolies would be able to enter the open U.S. market, while U.S. firms would not be able to reciprocate. This provoked a howl of indignation from many trading partners, and U.S. negotiators eventually backed down, but their view was accurate.

The tragedy of the Uruguay round is that U.S. officials did not realize that such national differences lay at the heart of the problems they were trying to solve. Had they made those differences the major focus, they might have had a real chance to revitalize the trading system. Because they did not, the GATT framework will continue to erode regardless of what may result from further machinations.

Beyond GATT

Fortunately, the trade-war scenario feared by many after the Uruguay round is unlikely. Disputes will undoubtedly occur, but most have been handled outside the GATT system anyway, and such arrangements can continue. Indeed, the fear of trade war will likely encourage negotiators to redouble such efforts.

The trend toward regionalism will probably accelerate. The United States has recently implemented a free-

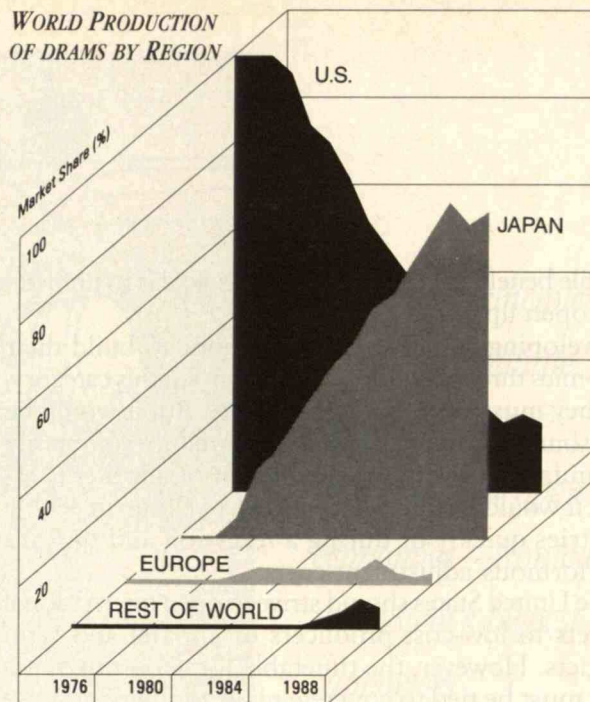
trade deal with Canada and will probably complete one with Mexico. EC '92 is well on track, while the expansion of giant Japanese multinationals in the Pacific is rapidly creating a de facto trading bloc there. These developments are not necessarily bad. The EC has been coalescing for 30 years while the United States and Canada have been intimately entwined for longer, yet these ties have not undercut trade and investment between Europe and North America.

Still, disputes will continue, and the world will have to work toward a sounder trading system. The United States, especially, needs to admit that it is advantageous to be a leader in industries such as aircraft and electronics, and that it cannot benignly neglect the adverse impacts of the current system on those industries.

Reciprocity should become the basis of future trade policy. That term has become a code word for retaliatory protectionist measures, and interpreted as a need to balance the volume of every traded item with every country. But a broad concept of reciprocity lay behind postwar negotiation of the GATT. The idea originally meant that U.S. and Japanese producers, say, should have roughly the same opportunities to invest, make acquisitions, distribute products, and otherwise do business in each other's market. This would not necessarily mean forcing Japan to adopt U.S. practice or vice-versa, but rather balancing the opportunities in some agreed manner. It is on this principle that the United States should take its stand.

Several categories of trade may require entirely different approaches within this broad framework. First is the kind, highlighted by Ricardo, that occurs when the United States has a climate suitable for growing Douglas fir, makes lumber out of it, and trades the lumber for bananas from Costa Rica, which has a warm wet climate. It would be silly for the United States to attempt to grow bananas on a large scale and impossible for Costa Rica to grow Douglas fir. Such trade occurs naturally, and present GATT rules are probably adequate to regulate it.

A second category includes products that can be manufactured in several areas but that some countries can produce with a clear natural cost advantage. Examples are often agricultural goods and apparel. Here the issue is who is the lowest-cost producer. For example, sugar is produced cheaply from cane in the Philippines, expensively from cane, sugar beets, and corn in the United States, and expensively from sugar beets in Europe. Ideally, the United States and Europe would halt production and import sugar from the Philippines, since improving farming techniques or working harder



Japan has assumed dominant world position in memory chips with tactics such as low-cost government lending and dumping below-cost chips on the U.S. market. The GATT

does not prohibit such practices, so U.S. production has precipitously declined in a technology that is the heart of numerous consumer and military goods.

will not enable those countries to lower costs to the Philippine level.

It was largely with this kind of trade in mind that GATT was initially established, and yet it is just here that GATT has been inoperable. That is because production of these items is often woven into a nation's economic and social fabric. Many people who make such products, including U.S. apparel workers, could find it difficult to obtain other jobs. Eliminating production would also provoke political repercussions, as the recent dispute over ending farm subsidies attests. Theoretically a nation's entire population should not have to pay higher prices on protected goods to save the jobs of a relative few. However, as in the case of Japanese rice or European farm goods, the many may be happy to bear extra costs because of ancestral roots, national pride, or a desire to avoid putting fellow citizens on the dole.

What's more, a country that has introduced child-labor laws, a minimum wage, and other social benefits may hesitate to undermine them by allowing cheaper imports from nations without such regulations. After all, it seems unfair to promise workers a minimum wage and then throw them out of work because that wage makes their labor uncompetitive. This situation is particularly problematic when the foreign country closes its markets to prevent imports of other goods that the laid-off workers could produce. The GATT has foundered on these issues because it is unable to count in-

tangible benefits and social costs—its goal is to immediately open up all markets.

Developing countries typically hope to build their economies through world trade in items in this category, and they must have that opportunity. But it would be unreasonable to expect one nation to reduce voluntarily its standard of living for the benefit of another. Certainly it would be folly for countries to eliminate whole industries quickly or during a recession and thus incur enormous adjustment costs.

The United States should strive to open international markets to low-cost producers of apparel and farm products. However, the timetable for achieving these goals must be tied to concrete plans for helping those affected switch to new areas of production. The costs of these adjustments could even be assessed on an international basis. Movement toward more open markets must also be tied to minimal levels of social and environmental performance. The United States would not open its borders to goods produced by slave labor. We should work to establish standards on child labor, industrial emissions, and other areas of social concern.

Finally, any further opening of the U.S. market must be conditional on similar movement abroad. Low-wage Asian countries want access to the U.S. market for apparel, which they can produce more cheaply than U.S. manufacturers. But they are unwilling to import U.S. fiber and fabric because they are trying to subsidize backward integration into those areas. Access to the U.S. apparel market should be conditional on ceasing such practices and on actual sales of competitive U.S. textiles in those countries.

A third kind of trade is conducted between governments, and includes the huge sales of military goods. Because prices and volume are completely managed, this trade occurs outside GATT. The United States has often subordinated its economic interests to political goals in pursuing such trade. Thus in 1990 it agreed to import from South Korea 130 percent of the value of the U.S. military aircraft sold to that country, and also to help Korea develop an aircraft industry of its own. More recently the Pentagon announced that its policy is to buy globally from the cheapest sources regardless of the unwillingness of foreign defense departments to reciprocate.

Here the United States must elevate its priorities and bargain on the principle that we get back in economic terms as much as we give. This means a halt to completing bad trade deals simply because they help diplomatic relations.

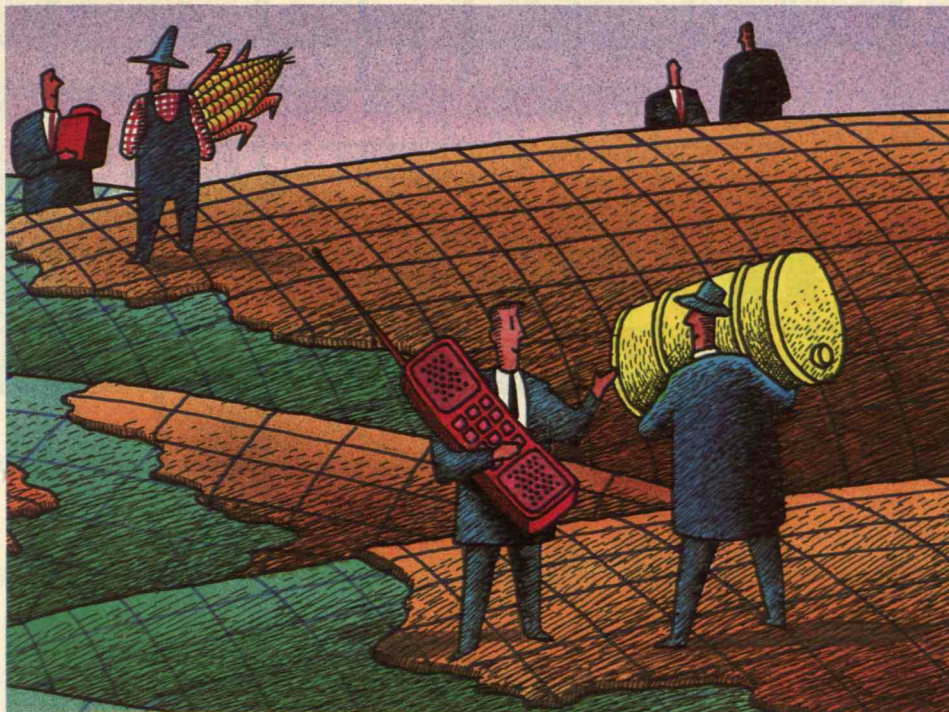
From Finger Pointing to Negotiation

Finally there is the trade category where most disputes occur and that requires the most negotiation: the industrial commodities and advanced technologies that a number of countries are capable of producing on a more or less equal basis. No comparative advantage stemming from climate, resources, or even wages dictates success in producing steel, semiconductors, or aircraft. Who becomes preeminent depends on factors such as fast introduction of technology and ability to obtain economies of scale. These industries usually raise a nation's overall productivity and help determine its international influence—a country that dominates world aircraft production is likely to gain both economic and political advantages that producers of shoelaces do not enjoy.

Here is where policymakers establish subsidies, import barriers, and consortia or cartels to obtain comparative advantage. Although the GATT national-treatment standard generally condones such policies, they inherently contradict free trade and are usually aimed at overcoming the leadership of some U.S. industry.

Even a country's more mundane economic practices can greatly influence comparative advantage in such industries. For example, even if U.S. and Japanese automakers attained exactly the same quality and production costs, U.S. producers would likely lose out. Why? Because it takes dealers to sell cars. Establishing a national dealer network from scratch in a country the size of the United States is an expensive and time-consuming task—as it is in Japan because of stratospheric real estate prices. But Japanese automakers selling in the United States don't have to build from scratch. They can piggyback onto existing GM, Ford, and Chrysler dealers because U.S. antitrust laws stipulate that producers must allow dealers to carry other lines. In contrast, by custom and because the Japanese do not enforce antitrust laws, outside firms find it extremely difficult to hook up with dealers in Japan. The result is predictable.

In these situations U.S. trade policy should insist on eliminating the disadvantages to U.S. industry. Negotiators should not do this with moralistic finger pointing: it is not unfair for other countries to have a different view of antitrust or industrial policy than the United States. If the Europeans want to subsidize the Airbus, that is their business. But we should be prepared to offset the negative effects of such subsidies on the U.S. air-



The core principles of GATT discriminate against societies with the most open economies—ironically, the system's biggest supporters.

craft industry, taking unilateral measures if necessary.

An example of how such a policy might work already exists in the form of international airline agreements. Nearly every country has at least one domestic airline, and many are subsidized or state-owned. If the United States applied the same policy to airline service as it does to auto and semiconductor trade, it would allow subsidized foreign airlines to fly unrestricted on both international and U.S. routes, even though U.S. carriers could not obtain reciprocal treatment. The United States would also allow foreign companies to buy total control of U.S. airlines. But we don't do that because there would soon be no U.S. airlines, and we have decided that retaining such an industry is important.

Thus we have responded not by accusing other nations of cheating but by negotiating a series of reciprocal deals that stipulate the number of destinations, flights, and landing fees for airlines from each country. Within this structure competition takes place: market shares fluctuate, passengers have meaningful choices, and subsidized airlines cannot run the others out of business. Critics have condemned this system as a deviation from pure free trade, but it has not prevented healthy growth in international air traffic, nor has the industry seen the bitter trade disputes common in steel, autos, and semiconductors.

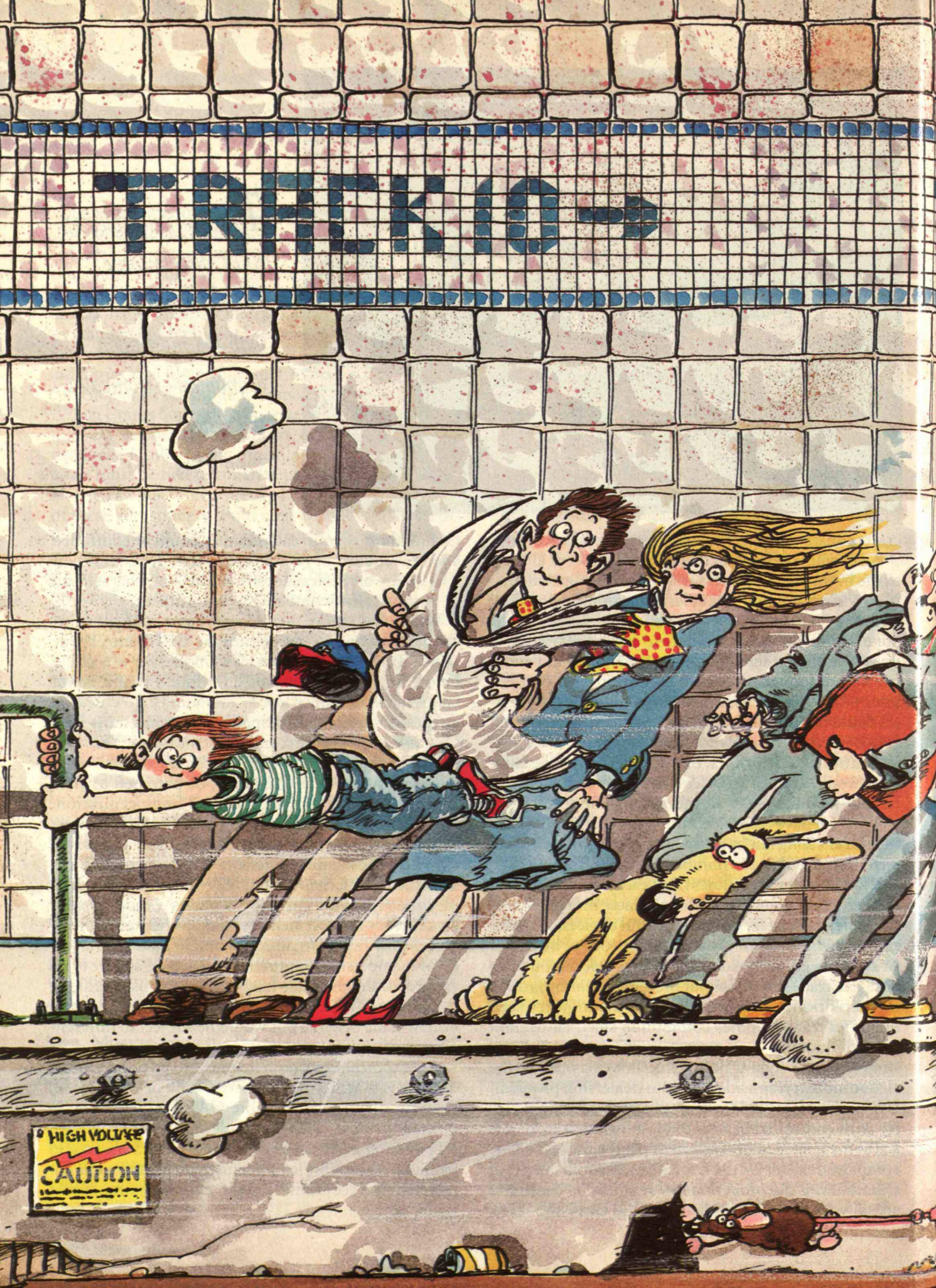
To see how such a policy might work outside the airline industry, consider the auto dealership problem. U.S. negotiators could require producers from a country with controlled dealers to establish their own outlets in the United States instead of piggybacking on U.S. company dealers. Or the United States could drop that stipulation if the other country requires its dealers to actually (as opposed to theoretically) carry U.S. cars.

Or half the dealers in each country could be controlled and half could carry both foreign and domestic lines. The nature of the deal doesn't matter, only that it result in an equivalent competitive environment.

While the United States negotiates such deals, it should also aim to restructure the GATT into a true World Trade Organization. The model for this could be the EC. The Europeans have found that it is not enough just to reduce tariffs and quotas. To create an integrated market, participating countries must have similar legal, regulatory, and social measures. The same is true in the world beyond the EC: those who want to move toward freer trade must be prepared to yield some sovereignty and accept some homogenization. Also key would be establishing a mechanism to pressure countries that run chronic trade surpluses, as well as to help those running deficits. Keynes actually envisioned such a mechanism in 1947—a tariff on the goods of countries with chronic surpluses would finance productivity improvements for nations running deficits.

A World Trade Organization might have several levels of membership. Some countries would adhere to all the provisions and trade freely among themselves along the lines of EC '92. Those unwilling to go that far would obtain some benefits but would be subject to different treatment.

An important question no one asks in today's trade debates is whether we want free trade or more trade. In a curious irony, the more GATT adherents have pushed for purity, the less trade they have produced. By pursuing a new approach, the United States could maintain its support for a liberal trade regime while enhancing its economic power and boosting world trade. ■



Beyond Planes, Trains, and Automobiles

Why the U.S. Needs a Maglev System

WHEN serious proposals are made for a 22-lane highway, you know something is wrong. Indeed, congestion, air pollution, and noise associated with highways and airways are steadily worsening. And the amount of petroleum used by transportation—63 percent of the country's total oil consumption—makes transportation a national security problem as well as an environmental problem. Building new highways and airports to relieve congestion not only creates new pollution but also entails exorbitant costs and takes up a great deal of land. Clearly the U.S. transportation system needs to be expanded, but just as clearly the technology that is used must consume less land, airspace, and natural resources. The question is, what transportation technologies, if any, will be able to meet these require-

A new mode of transport based on magnetic levitation can ease traffic, speed travel, and save energy. But the federal government and major companies need to take a stronger lead in getting the technology off the ground.

BY RICHARD D. THORNTON



High-speed trains like Japan's Shinkansen, with its top speed of about 125 mph, are competitive with cars and planes in countries where population densities are high and travel distances relatively short. But to be practical in the U.S., high-speed ground transportation must routinely travel at 200 to 300 mph.



ments and still be acceptable to a public that has grown accustomed to highways and airways?

Some visionaries propose "intelligent vehicle highway systems," which would use electronics and communications to minimize traffic problems. While this approach might ease highway congestion—and cut energy consumption a small amount—it would continue our reliance on fossil fuels. Even if cars were converted to electric power, they would still be limited in their potential for increased speed and improved safety.

High-speed rail like the Japanese Shinkansen and the French Train à Grande Vitesse, or TGV, is not the solution, either. The TGV operates on its just-completed Atlantique line at a top speed of 186 mph, but its station-to-station passenger speed is only 134 mph. With the short travel distances and high population densities of European countries, this speed is competitive with other forms of transportation. But in this country—with its longer travel distances and more diffuse population—high-speed rail would be hard pressed to compete with air travel for distances greater than 250 miles or with cars for much shorter distances.

Although a shortened TGV train has gone 320 mph in a test run, passenger service at this speed would be prohibitively expensive in track maintenance and energy consumption, and would offer only a modest increase in station-to-station speed. So despite proposals for high-speed rail on a few U.S. routes—such as Tampa to Miami, Dallas-Fort Worth to Houston, and Cleveland to Columbus—this mode of travel is unlikely

RICHARD THORNTON is a professor of electrical engineering and computer science at MIT. He worked with Henry Kolm and others to develop the Magneplane test vehicle in the early 1970s. This work led to international patents on the active-guideway linear synchronous motor, now used on all high-speed maglev vehicles.

to become widespread in the United States.

The most promising solution to our transportation woes is magnetic levitation, or maglev. This is a generic term for any transportation system in which vehicles are suspended and guided by magnetic forces instead of relying on wheels or aerodynamic forces. Magnets also propel a maglev vehicle forward. Ideally, maglev can offer the environmental and safety advantages of a high-speed train, the speed and low friction of an airplane, and the convenience of an automobile. But although it has some of the attributes of these other vehicles, it is truly a new mode of travel—and it will enhance the other modes by relieving congestion and providing connections among them.

Maglev travel would be fast. Not only would the vehicles operate at 150 to 300 mph, but they would load and unload off the guideway to keep traffic moving, and they would be small enough to allow point-to-point travel with infrequent stops. Accordingly, maglev vehicles could provide half the travel time of high-speed rail. Their travel time would be less than that of jet aircraft for distances as great as 1,000 miles, and less than that of automobiles for distances as short as 100 miles. In the more remote future, magnetically levitated vehicles traveling in evacuated tubes could be even faster, zooming from New York to Chicago or Chicago to Los Angeles in an hour or two. Maglev can improve over both highway and air travel in energy efficiency, environmental impact, energy source flexibility, safety, and—most important—cost.

The technology is available; the problem is financing. Industry lacks incentive to make major financial commitments to maglev because of the long-term nature of the investment and the low probability of reward when faced with a huge range of technical alternatives and political uncertainties. There are so many unknowns that not even the most farsighted business leaders are sure where to invest. Help must therefore come from the federal government, as has been the case with the early development of every major mode of transportation. If a federal initiative is timely, industry will pitch in, and taxpayers will be amply rewarded—just as they have been by past initiatives for railways, highways, and airways.

Why Maglev?

The benefits of maglev compared with other modes of travel are many. In an age of growing U.S. vulnerability to disruptions in oil supplies, maglev offers a form of transportation powered by electricity, which is only 30 percent dependent on petroleum. What's more, maglev vehicles use only a quarter to a half as much energy as jet aircraft and private automobiles.

They also have a relatively low environmental impact. They make less noise than any other system at

the same speed; all observers of high-speed maglev test vehicles have commented that the noise is surprisingly modest. Similarly, the land required for maglev is less than for any other mode per unit of capacity. Although a 100-foot maglev right of way is only twice as wide as a railway right of way, a "magway" can carry five times as many passengers per hour. And airports, though not directly comparable, are clearly more land-intensive than magways. The Dallas-Fort Worth Airport occupies 17,800 acres, enough land to create a maglev corridor 100 feet wide and 1,466 miles long. The new Denver airport will occupy comparable land—several times that of a magway with the same capacity based on average jet-travel distances.

Better still, building a magway need not cause massive environmental destruction. The French and English have found that many communities want a station on a high-speed train line but do not want the line to be built on new rights of way that slice their towns in half. Most of a U.S. maglev system could be built on existing interstate highway rights of way with negligible disruption.

Maglev also promises to be safer than any other mode of intercity travel. The closest comparable mode is high-speed rail. The passenger fatality rate for the Japanese Shinkansen and the French TGV is reportedly zero after billions of passenger miles of travel. For comparison, the fatality rates are 0.4 per billion passenger miles for intercity jet and bus and 10 for private automobiles. Like high-speed rail, maglev will use mostly elevated guideways that are unlikely to be encroached on, and it does not require on-board fuel, which can cause fatal fires in an accident. Similarly, it will have sophisticated automatic control systems, will receive frequent automated inspections, and will likely attract the most competent operational personnel.

Maglev can be even safer than high-speed rail if it is designed with less possibility of derailment, more automatic guideway sensing, and controls that are more resistant to human errors. And because the vehicle does not touch the guideway, accidents related to weather and wear will be minimized.

The initial capital cost of maglev need not be higher than the \$8 million to \$10 million per mile required for a TGV system or for new interstate highways, and the maintenance can be substantially less than the TGV cost of \$2 to \$3 per train mile. The higher speed will attract more riders, making the final system less expensive to the user than a slower high-speed rail system.

What's more, maglev vehicles could carry freight at rates competitive with trucks and with shipping times only a little longer than by air. Even if maglev shipping were more expensive than trucking, businesses would frequently pay a premium for speed. Witness the dramatic success of overnight courier service and the trend away from railways to highways for shipping in spite



The 250-mph MLU002 demonstration vehicle embodies Japan's heavy investment in first-generation maglev—technology the U.S. can supersede if government and industry increase their commitment.

of the higher cost per ton-mile. Recognizing this trend, the Germans plan to carry freight on their new 155-mph Inter City Express rail system, and recent studies suggest that piggyback freight capabilities could dramatically improve the already strong economic advantages of maglev.

Where Things Stand

So far, U.S. efforts toward reaping the benefits of maglev have proceeded in fits and starts. Pioneering maglev research was done in the United States from the late 1960s until 1975, when the Office of Management and Budget canceled all federally funded work. In 1988, however, Sen. Patrick Moynihan (D-N.Y.) and other members of Congress introduced legislation aimed at restarting a U.S. maglev effort. The Senate Committee on Environment and Public Works established the Maglev Technical Advisory Committee the same year, and its report helped launch the new National Maglev Initiative.

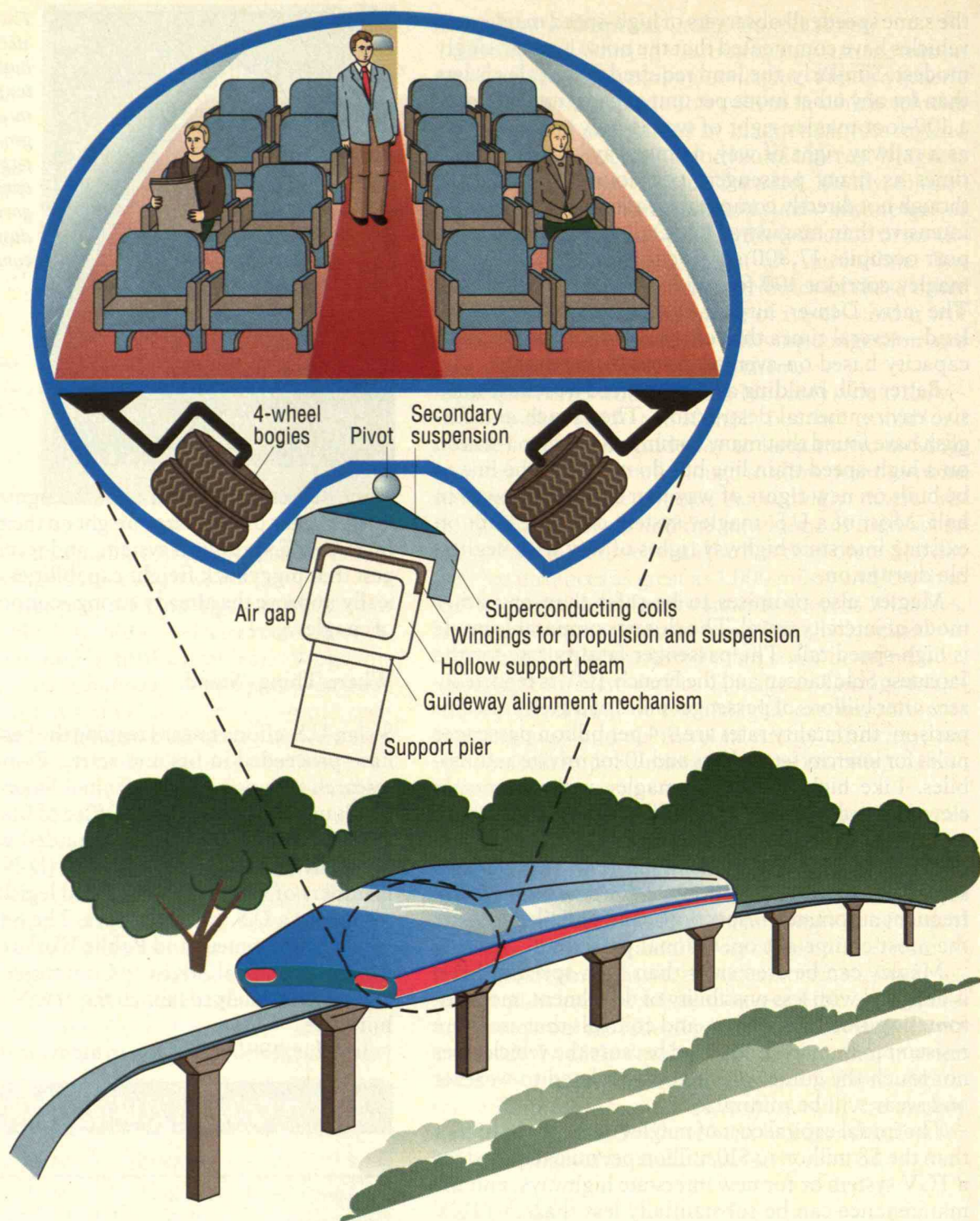
In May 1990, the Department of Transportation

EFFICIENT SIZES FOR MAGLEV VEHICLES

	SMALL	MEDIUM	LARGE
Passengers	50	150	450
Freight (tons)	12	40	120
Width (feet)	8	13	13
Height (feet)	12	13	13
Length (feet)	40	100	260
Vehicle weight (tons)	12	30	80

Maglev experts generally recommend starting an interstate system with medium-size vehicles. Later, small vehicles

could be used for local distribution, large ones for transcontinental passenger and freight service.



Above: In an emergency, a maglev vehicle might have to stop on a banked curve. To prevent discomfort to passengers, a tilting mechanism—such as one in which the passenger compart-

ment pivots on its undercarriage—would return the vehicle to an upright position.

The diagram also shows an innovative guideway consisting of a single hollow

beam instead of a pair of "rails." This design would cost less and be easier to align with the vehicle's magnets. Right: Built on a highway median strip, a maglev station would use land

efficiently. Vehicles could enter and exit via ramps above the guideway by lowering sets of rubber-tired wheels. The elevated guideways would allow ample parking beneath.

(DOT), the U.S. Army Corps of Engineers, and the Department of Energy sponsored a "Maglev Forum" to help launch this initiative. In October 1990, DOT issued a request for abstracts of proposals to study specific design issues. It received about 270 responses, mostly from universities and small companies. The department issued a "concept definition request for proposals" in February 1991. So for now, at least, U.S. maglev is still alive.

In contrast to the uneven U.S. record, Germany and Japan have steadily conducted maglev research since the early 1970s. In 1989 the German Transrapid 07 carried passengers at speeds over 250 mph on a 19-mile test track. The same year, the Japanese demonstrated the MLU002, which uses different technology but has achieved about the same speed. The earlier Japanese ML500, a passengerless test vehicle, reached a speed 1 percent greater than the TGV record, but to date no maglev test system has carried passengers faster than the Transrapid.

The biggest stumbling block to a major U.S. maglev system is the apparent unwillingness of either the government or private companies to make a financial commitment large enough to proceed past preliminary R&D. And despite the commendable start represented by the latest research efforts, a national initiative sorely needs the participation of additional large companies. Nevertheless, high-speed maglev is now at the point that railroads were at in the 1820s: plans are being made, and a groundbreaking appears likely.

Several regions of the country, realizing that good transportation can contribute strongly to economic growth, spent millions of dollars in the 1980s studying the suitability of high-speed rail and maglev for specific routes. Two construction plans for high-speed maglev are now in the works: a 250-mile, 70-minute route from the outskirts of Los Angeles to Las Vegas, and a 13-mile, 5-minute airport connector in Orlando, Fla. Both are slated to use the Transrapid system,

but neither is fully committed and funded yet. Because of their potential to attract tourists, these projects have unique economic justification—cost is not the only consideration. In fact, less than a third of the guideway cost is expected to be borne by fares.

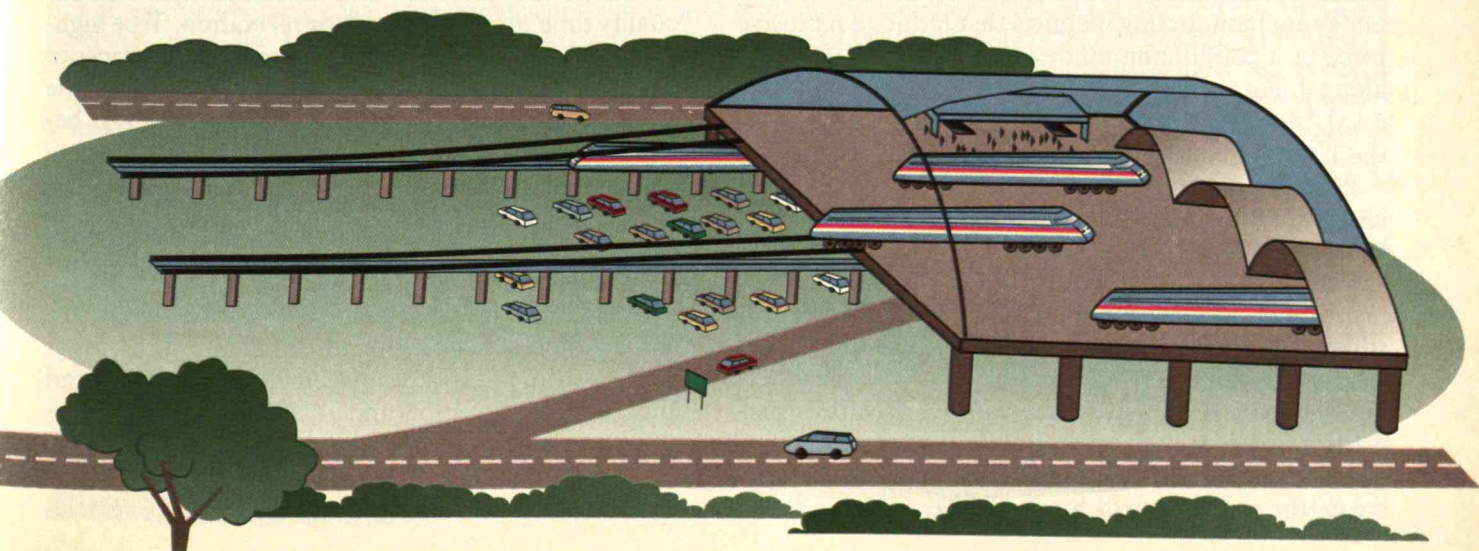
Most U.S. maglev experts believe that the Transrapid design is unsuitable for major application in the United States. Because the technology it uses requires a very narrow gap between vehicle and guideway, Transrapid's guideways are expensive and difficult to build, align, and maintain. If the small, regional projects are implemented, however, they may ignite U.S. efforts to develop the next-generation technology.

Designs for the U.S.

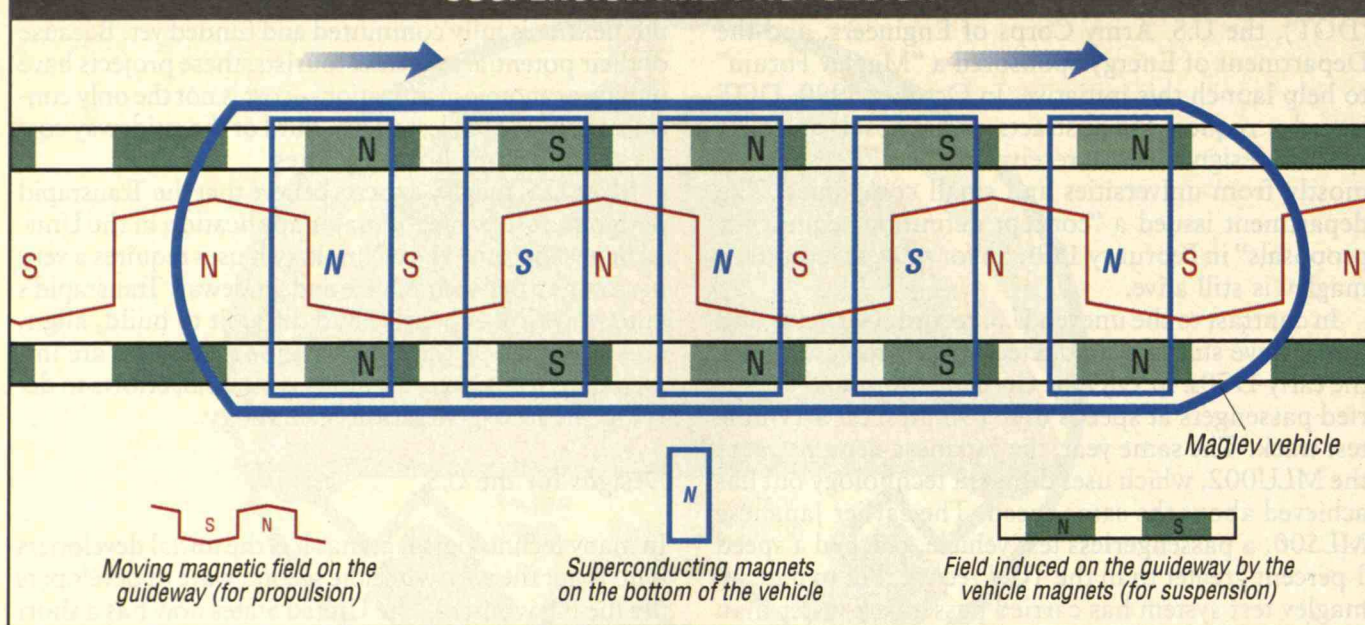
In many technological arenas it is the initial developers who point the way, while the second wave of developers are the big winners. The United States now has a short window of opportunity to pass Germany and Japan by building a second-generation maglev system that reduces passenger costs and environmental liabilities. The advantages of staying ahead in transportation technology have been amply demonstrated. Boeing's dominance of the commercial jet aircraft market, for example, has been one of the single largest contributors to reducing the U.S. balance-of-payments deficit. Deciding to create, rather than consume, maglev technology and vehicles will have a comparable effect. Over a 20-year period, the United States could export \$20 billion to \$50 billion dollars of maglev technology instead of importing the same amount.

Here are some of the elements of a maglev system that need to be considered in order for this second-generation technology to succeed.

SUSPENSION: Magnetic levitation can be designed in as many ways as electric motors, and focusing on the best approach is the critical task for the next year. There are two basic types of maglev. Electromagnetic suspen-



SUSPENSION AND PROPULSION



Maglev requires separate forces for suspension and propulsion. In electrodynamic suspension—the preferred levitation system for the U.S.—magnets on the moving

vehicle induce a levitative field on the guideway. (Whatever the polarity of the magnet—north or south—the field it induces will produce a repulsive force.) In a linear

synchronous motor—the recommended form of propulsion—the same magnets are pushed and pulled by a magnetic field that travels along the guideway in syn-

chrony with the vehicle. A feedback control system changes the polarity of this field, so that a guideway section marked "S" becomes "N," and vice versa.

sion (EMS)—the kind used by Germany's Transrapid—depends on attractive force. In EMS, electromagnets on the vehicle are drawn toward a pair of steel rails. Although the bulk of the vehicle rides *above* the rails, the magnets are in a part of the vehicle that wraps *beneath* the rails. As the magnets pull the vehicle upward, their current is electronically regulated to maintain a constant gap between the rails and the vehicle.

Electrodynamic suspension (EDS)—the kind of levitation used by the Japanese MLU002 and the Magneplane test vehicle, which Henry Kolm and I developed at MIT in 1970—is based on repulsive force. Instead of using electromagnets and steel rails, the vehicle contains superconducting magnets that induce a repulsive force in a conducting guideway as the vehicle moves along it. For various reasons, the Senate's Maglev Technical Advisory Committee has recommended EDS for the United States (*see the sidebar opposite*).

PROPULSION: Although there are many types of linear electric motor—the system that propels a maglev vehicle forward—only one is suitable for EDS maglev: a design known as a linear synchronous motor (LSM). A magnetic field travels along the guideway, acting on superconducting magnets attached to the vehicle. By keeping the vehicle motion synchronous with the traveling field, the propulsive force can be forward, backward, or even straight up or down. In a typical design, the same superconducting coils that create the lift also create the reaction field for the LSM.

SPEED: The future may see maglev used for medium-speed city transit, high-speed auto ferry, and very-high-speed evacuated tube travel. But the important application now is for transporting people and freight at speeds from 200 to 300 mph for distances of 100 to 1,000 miles. This is the ideal speed range for maglev, and it is a range not well served by other modes.

It is important that we not only create a vehicle with a high top speed, but also provide high passenger speed from origin to destination. In a recent 400-mile trip by jet from Boston to Baltimore, my door-to-door travel time was over four hours each way, even though I spent less than one in the air—and that hour was the only "quality time" usable for work or relaxation. True high-speed ground transportation requires that distances to and from the system be relatively short, with less time spent walking (running?) and waiting (sleeping?) between one mode of travel and the next.

Thus, although popular articles refer to vehicle speeds of over 300 mph, and although such speeds are certainly achievable, I favor an operational top speed of 250 mph. The money saved by going slower can be channeled into providing better access. On- and off-ramps should be spaced no more than four times as far apart as on an interstate, and vehicles should load and unload near parking lots and public transport. Achieving high point-to-point speed also means that the traveler should make very few intermediate stops.

VEHICLE SIZE: Most maglev experts advocate vehicles

with capacities in the 100- to 200-passenger range. But as the technology matures, we will almost certainly want to expand the capacity by using larger vehicles, and employ smaller vehicles for local distribution.

The smallest vehicle would resemble a large bus and could be outfitted with wheels to operate on the highway as well as on the guideway. A medium-size vehicle, the kind I propose implementing first, would resemble a Boeing 757 with no aerodynamic surfaces or engines, and would be able to taxi within a "magport." The largest vehicle would resemble three medium-size vehicles linked together. It would be ideal for transcontinental pullman service and heavy freight.

VEHICLE SPACING: Vehicles would operate at headways (distances between vehicles) as short as 15 seconds, and would be switched off the main guideway for loading and unloading. A 15-second headway allows emergency stopping in the clear distance ahead, and is dramatically safer than the 2-second headway common on crowded interstate highways. When a vehicle enters or exits the guideway, another 15- to 30-second tailway or headway is required. But even with a relatively high proportion of short-distance travel, the average

headway could be as low as 30 seconds. For optimal capacity, vehicles would travel in a group, with the last one scheduled for the first stop, and so on.

With 150-passenger vehicles running half full, and with an average headway of 30 seconds, a guideway would carry 9,000 passengers an hour—twice the capacity of a very crowded four-lane interstate with cars carrying two passengers each. With 450-passenger vehicles, the capacity would be six times as high as an interstate. TGV will carry 4,500 passengers an hour when half-full 450-passenger trains are running every three minutes.

TILTING: Most of a U.S. magway system would be built on or near interstate highway rights of way. Thus maglev vehicles must be able to negotiate almost the same turns and grades as lower-speed highway traffic. A study by Grumman and others for the State of New York shows that at 240 mph, a vehicle would have to tilt at an angle of plus or minus 24 degrees to avoid unacceptable sideways force or frequent deceleration for turning. Part or all of the tilting can be done by banking the guideway. But in an emergency a vehicle might have to slow down or stop during a turn, so it must be

Why Repulsive Maglev Is So Attractive

OF the two basic methods for providing levitation—electromagnetic suspension (EMS) and electrodynamic suspension (EDS)—the latter appears to be more suitable for wide use. The main drawback of EMS systems, which rely on attractive force, is the need to maintain a narrow air gap. This problem arises because EMS vehicles must use magnets with normal conductors, such as copper or aluminum, instead of superconductors. Attractive systems are unstable unless the current in the magnets can be varied widely and rapidly, as is possible with normal magnets. Without a way of controlling the current, the attractive force increases as the gap decreases, further narrowing the gap until, finally, it closes.

No maglev system that requires magnets with normal conductors can operate with an air gap greater than about three-eighths of an inch without unacceptable power consumption, vehicle weight, and guideway cost. A wider gap might be feasible if an attractive system could use superconductors, but all known superconductors must operate with essentially constant current, and thus cannot be controlled in the way that is necessary to keep a stable gap.

In contrast, a repulsive, or electrodynamic suspension, system is inherently stable. The current induced in the guideway will increase as the gap shrinks, thereby increasing the repulsive force and providing steady suspension. Since the vehicle's magnetic

field can be constant, it can be supplied by superconducting magnets, allowing a gap of two to six inches. As a result, EDS guideways do not require nearly the precise alignment or constant maintenance of EMS guideways.

No new technology is needed to make an EDS system practical: low-temperature superconductors are more than adequate for EDS systems, and reliable closed-cycle refrigeration equipment is now in everyday use. We simply need to design a system that uses existing technology in an optimal way.

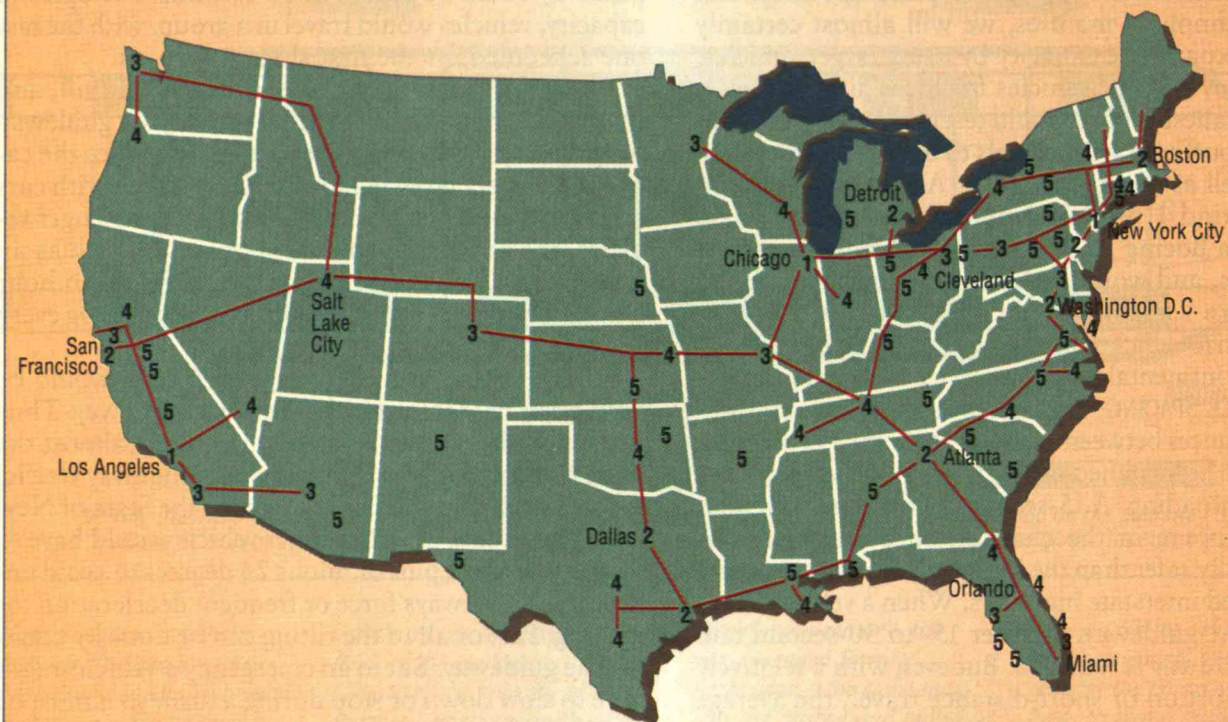
Electrodynamic suspension does have its drawbacks. Systems built so far have been less efficient and have required more power than existing EMS designs. But this problem can be minimized by

replacing the continuous sheets in the guideway with cleverly designed coils that use less current.

Another drawback is that because the magnetic fields on the vehicle are stronger than in an EMS system, more money and effort must go into shielding people from them, both inside and outside the vehicle. It is now believed that to avoid any health risk, the fields from a maglev suspension should be not much greater than the earth's magnetic field anywhere there are likely to be people. Nevertheless, the ability to use a wider gap, lower-cost guideways, lighter vehicles, and higher speeds would more than compensate for the added development cost for a practical EDS system.

—Richard D. Thornton

AN INTERSTATE MAGWAY SYSTEM



able to tilt back to a close-to-level position to compensate for the banking of the guideway.

Although no existing passenger-carrying maglev vehicle provides controllable tilting, trains that tilt are made in several countries, and the U.S. Department of Transportation has determined that they are acceptable to passengers as well as technically reliable. Amtrak may even introduce them on the U.S. Northeast Corridor. A second-generation maglev design should be able to tilt at least plus or minus 12 degrees.

GUIDEWAYS: Elevated guideways will probably be required in all densely populated areas. Most will be no higher than is necessary to allow vehicles, people, and animals to pass underneath, but some may have to pass over interfering bridges at heights of 40 feet or so. Interestingly, some studies indicate that a well-designed elevated guideway for maglev can be less expensive than at-grade construction; there is less earth to move, and construction can use more automation.

The guideway can be lighter than an elevated railway, because maglev vehicles themselves are much lighter than rail cars. While TGV (which is considered a lightweight train) weighs over 1 ton per passenger and each axle carries up to 17 tons, a maglev vehicle is expected to weigh about a third of a ton per passenger. And even though maglev vehicles are wider than most trains, the loading per foot of vehicle length is less. Maglev guideways can also be lighter because loading is more uniform and because they don't have to stand up to wear caused by wheels.

A 10,000-mile maglev system could link all major U.S. transportation hubs, as well as many secondary ones. Hubs are ranked on a logarithmic scale according

to current and projected population and frequency of air and rail service. The highest rank is 1. Hubs that will produce half the ridership are labeled 2, and so on.

Existing maglev designs use relatively complex guideways, such as U-shaped channels with two rail-like elements. But a more practical alternative may be to use a single narrow beam, with a vehicle that wraps around it like a monorail. This design would cost less. One reason is that it could use a hollow box beam only about a meter square, so it would require less material and labor to build. Another is that vertical, horizontal, and tilt adjustment is easier with one rail than with two. An added benefit is that the magnetic fields would be more confined and thus easier to shield. In fact, a ferromagnetic shield could be part of the vehicle frame. A narrow-beam elevated guideway would also be less intrusive than a wide structure.

SWITCHING AND STOPPING: A limitation of electrodynamic suspension—the preferred type of maglev for the United States—is that it cannot provide levitation at low speeds. This means that vehicles will need auxiliary suspension when they are switched off line for unloading and loading and when forced to stop between off-ramps.

For loading and unloading, the most widely accepted proposal is to use rubber-tired wheels. Like the MIT Magneplane design, vehicles could use wheels that ex-

tend laterally to engage an upward-sloping off-ramp. The integrity of the guideway is not breached by this scheme, as it is with the railroad-style guideway switch that is commonly proposed. To minimize the need for other traffic to slow down, a vehicle would exit and enter the guideway at 60 mph.

Providing for stops in an emergency is more complicated. Although a maglev vehicle traveling at 250 mph could easily come to a halt in a mile, getting it restarted would require special measures. It would be possible to have ramps for wheels running the length of the guideway, so the vehicle could roll until it reached a high enough speed for levitation. But this would be prohibitively expensive. If the power system did not fail, the linear synchronous motor could be programmed to provide enough lift to support the vehicle at low speed while stopping and restarting. If the power grid failed, however, emergency generators would be activated to allow all vehicles to travel at reduced speed to the next offramp. In an extreme worst case, the vehicle would "land" on the guideway and coast to a stop on disposable skids.

A Nationwide Magway System

An ideal place to begin large-scale maglev service would be the 450-mile Northeast Corridor from Boston to Washington, D.C.—home to 40 million people, or 16 percent of the U.S. population. The region has 10 major airports and several smaller ones handling a total of over 4,000 commercial jet landings a day; 4 of these airports are among the 11 most congested in the country.

But maglev won't become a truly significant mode of travel until there is a nationwide interconnected network. If we take into account the population of major transportation hubs, the frequency of existing air and rail service, and projected population growth rates, we can rank the nation's transportation hubs and devise a relatively simple network that serves all major hubs and many secondary ones as well. Such a network would connect all major city pairs and even allow overnight pullman and package service from coast to coast.

For a maglev system on this scale, present airport and railroad ticketing, loading, unloading, baggage handling, car rental, and parking procedures will all have to be completely rethought. In the process, system designers can belie a claim made by some detractors of maglev: that Americans are so in love with the private automobile that nothing can replace it. In reality, most people do not relish long drives on the interstate system, and endure the highway only because they believe it to be less costly and they want the convenience of a car at the end of the trip. Both of these advantages can be achieved with a creative maglev system in many parts of the country.

Where the guideway is built on the edge of an interstate highway right of way, the user will have good access to boarding stations. Land under the guideway can be used for parking, and shuttle buses can pick up motorists and take them to the nearest maglev terminal. In fact, rubber-tired maglev vehicles could travel short distances on existing highways. That way, only modest additional land would be required for terminals. This could lower the overhead cost of car rentals and reduce the cost of parking. In fact, it may be possible to design a totally automated car rental system, with user ID cards in lieu of keys, and reservations made during the maglev journey.

Another scenario is to use minivans for collecting and distributing passengers and freight. The minivans would be telephone-dispatched like taxis. They could pick up several passengers from their homes or offices and carry them and their luggage directly to the maglev vehicle (no races down airport corridors!). En route, fares could be collected and passengers could schedule another set of minivans to collect them from the maglev terminal at the other end and take them to their destination.

Such a minivan system would allow a much shorter total travel time without the hassle of trying to park and load at a large terminal and then having to hire a car or take a bus at the other end. Various communities have experimented with dial-a-ride public transport, and maglev might be the ideal application for this idea. There is even the intriguing possibility of eventually using electric minivans that are charged while loading and unloading, further cutting air pollution in city centers.

Although the minivans should be operated by independent taxi drivers, it is essential that any maglev system avoid the inefficiencies of existing airport taxi systems. Often entirely different sets of cabs are used for collection and distribution at the same airport, and sharing rides is chaotic at best.

Creating a truly efficient transportation system may require a new approach to automobile ownership, in which a company or person leases the right to use any one of a national fleet of vehicles. Drivers would leave their vehicles at the station and board the maglev vehicle. On board, they would electronically "turn in" the cars and reserve new ones at their destination. The new car would then replace the old one as the driver's "own" car until further notice. Equivalent cars would be waiting for them when they return, but in the meantime their "old" cars could be leased or maintained, reducing rental and parking costs. It might actually be fun to have a "dynamically owned" car and eliminate many of the usual ownership problems. This migratory ownership might make electric vehicles more practical, since they would not be used for long-distance travel.

To be viable, a national maglev system would have

The author displays a scale model of the Magneplane, an early maglev design he helped develop at MIT.

to replace not only short-distance air travel but a significant fraction of interstate highway travel as well. One way to do this is with maglev "ferries" that can carry passengers in their own cars. This approach would be not only a lot faster than driving but also a lot safer. And a large maglev vehicle carrying 40 small cars would use no more energy at 240 mph than the cars would consume at 60 mph. Auto ferry service would have about the same cost per rider as conventional service if most of the car seats were occupied. It would allow companies to transport special vans equipped for demonstrations or for on-board conferences or work so that a traveler's time would not be wasted.

What Will It Cost?

Surprisingly, maglev can be a low-cost travel mode. In July 1990 Bechtel proposed to build a Transrapid system from Los Angeles to Las Vegas for \$20 million per mile. This is about twice the cost of a new interstate highway or a high-speed railway. However, it is based on the more expensive EMS design, with its heavier vehicles, tighter guideway tolerances, and more expensive guideways. Recent studies at MIT indicate that a second-generation EDS design can reduce the cost to perhaps \$6 million to \$8 million per mile, excluding land, which is not a major cost except in densely populated areas. In high-density corridors there is the additional cost of reconstructing interfering structures, but this outlay would be greater for highways, because they use more land, and for high-speed railways, because they need a straighter right of way.

A section of guideway traversed by an average of one vehicle every minute for 12 hours per day would carry over 250,000 vehicles per year. At that rate, a guideway amortization cost of \$1 million per mile per year would require a charge of only \$4 per vehicle mile, or \$0.05 per passenger mile for a half-full vehicle.

Operating cost could also be reasonable. Assume that 150-passenger vehicles are half full and consume 5 megawatts when traveling 240 mph. If electricity costs \$0.10 per kilowatt-hour, the energy cost is \$0.03 per passenger-mile, or half that of air travel in the 100- to

1,000-mile range. Vehicle and labor cost can both be less than half that for air travel, since the vehicle does not have a propulsion system or wings, uses a smaller crew, and can travel almost as many miles a year as an airliner on routes of up to 1,000 miles.

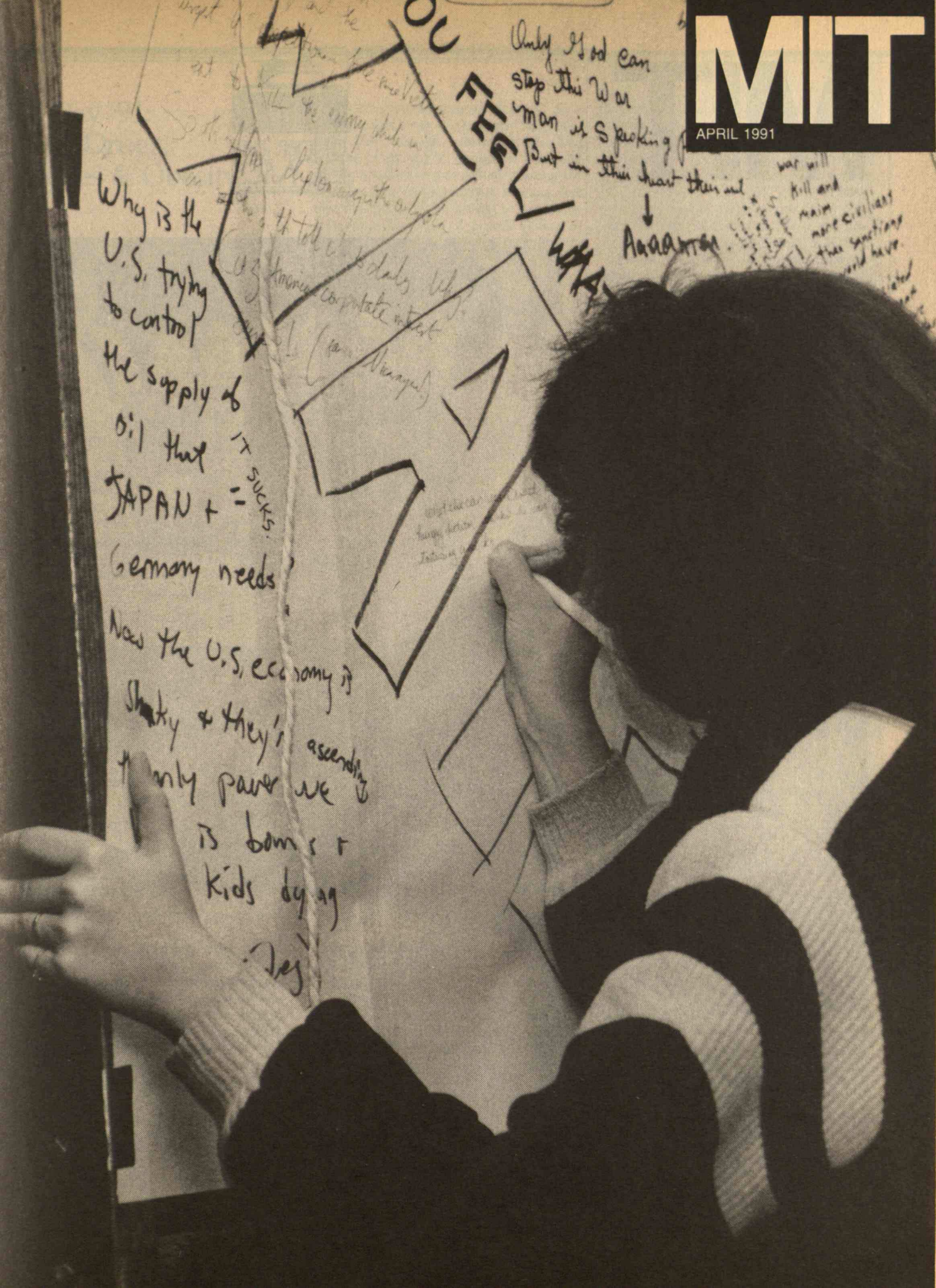
With enough demand, fares could be highly competitive. While coach air fares in the Northeast Corridor are now \$0.50 per passenger-mile, the projection for maglev on the same route is less than \$0.25 per passenger-mile, with at least a 50 percent discount for off-peak travel. A full-fare one-way ticket from Boston to Washington, D.C., might cost around \$100.

More important—since at least three-quarters of all intercity passenger travel is by automobile—fares should be low enough to lure people out of their cars. In 1990 the estimated cost of operating a car was \$0.25 per mile, excluding tolls. Thus, normal maglev fares can compete with a car carrying one person; off-peak fares, with a car carrying two people.

The important question is: Can low travel costs stimulate enough passenger and freight demand to make the low fares possible?—the proverbial Catch 22.

A local maglev system with relatively high cost and infrequent service—the kind of system most studies have looked at—may require an infinite subsidy. But no maglev study has seriously considered the economics of a national system with high point-to-point speed,





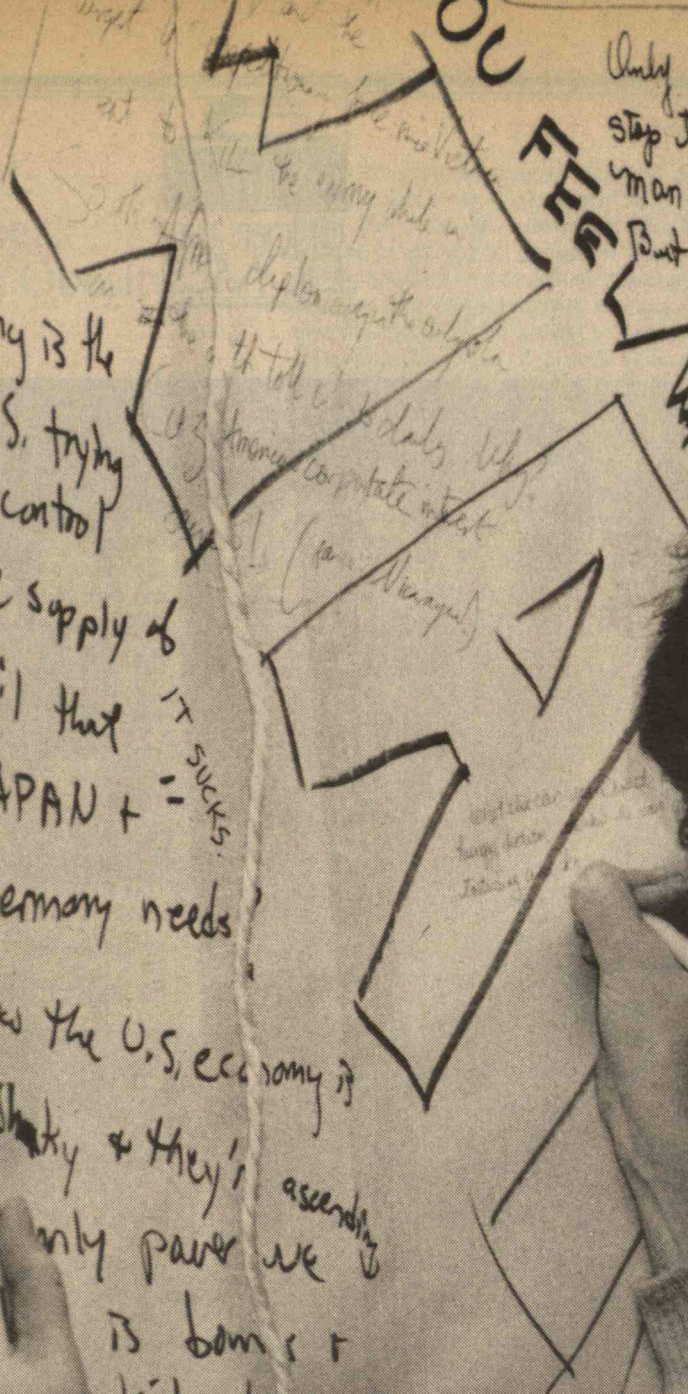
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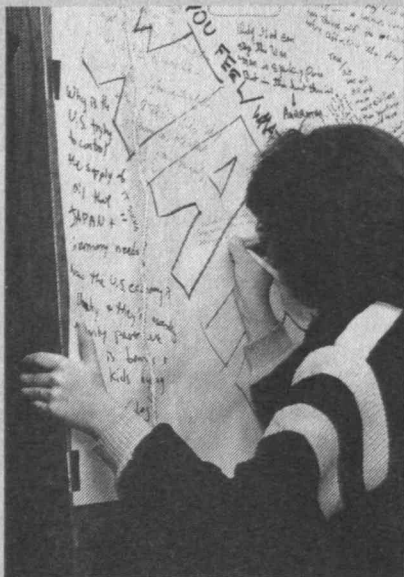
Only God can
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Assassination

war will
kill and
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COVER

A war bulletin board set up in the Student Center during IAP gave members of the MIT community an opportunity to vent their fear, frustration, anger, and patriotism. And vent they did, from the thoughtful to the profane. Photo by Frank Revi

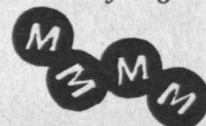


UNDER THE
DOMES



Melts in your mouth, not in your hand, eh? But why? Unfortunately, when the M&M/Mars Co. developed their special coating for M&Ms decades ago, it didn't bother to detail the physics behind the process. To do that, and with an eye toward improving the speed and economy of producing the candies (currently 200 million per day,) the candy manufacturer enlisted the research assistance of four MIT undergrads enrolled in the Chemical Engineering Laboratory. From left, Joe Berghammer, '91, Neelan Choks, '92,

Jeffrey Falkowski, '92, Ashley Shin, '91, and Professor Jeffrey Feerer started experimenting late last fall on the nearly one ton of uncoated plain and peanut centers shipped from the factory. The MIT community had to be enlisted to help "dispose" of the results of their research—all green, very edible, and lacking only the little white M. Now if someone in the lab would just solve the mystery of how they manage to print that tiny letter on every single one. . . .



T-Day '91: Sex, Drugs, Genes & Obesity

Surely there isn't a single MIT graduate whose family and friends have not been touched by heart disease, cancer, AIDS, obesity, or the hereditary component in a variety of medical conditions. These are areas in which the MIT Biology Department has built its research program—not only because they involve discoveries at the frontiers of molecular biology and related sciences, but because they are also the medical issues of broadest public concern today.

In setting up Technology Day 1991 around these topics, the Biology Department and the T-Day Committee are planning to involve alumni/ae and their questions in shaping the discussion.

After the morning session in Kresge, where an expert panel will lay a groundwork of basic science and discuss MIT achievements in these areas, alumni/ae will have their choice of a number of

small afternoon sessions devoted to a single topic, but from many perspectives. For example, afternoon panelists will be prepared to comment not only on the implications of genetic testing for families carrying hereditary disease, but also the role of DNA testing in the courtroom and the abuse of genetic testing in the workplace. Alumni/ae will be encouraged to consider the social and ethical issues as well as the science and medicine involved.

The morning speakers are all leading members of the MIT Department of Biology, including:

■ Eric Lander, a mathematician who is the chief investigator on MIT's team for the national project to map the human genome;

■ Robert Rosenberg, PhD '79, an MD who is also head of the hematology department at Boston's Beth Israel Hospital and an expert on atherosclerosis and heart disease;

■ Herman Eisen, an expert on the function of the immune system and authority on AIDS;

■ Robert Weinberg, '64, a pioneer in the discovery of oncogenes who will speak on cancer.

Each of the speakers will lead the afternoon session on his topic, heading panels that include professors from the Harvard Medical School, members of the research staffs at Boston hospitals, and members of the MIT School of Management and the Departments of Biology, Urban Studies and Planning, and Brain and Cognitive Sciences.

There will also be a fifth afternoon session on biotechnology and technology transfer, headed by Professor Phillip Sharp, director of the MIT Center for Cancer Research, with panelists from the Biotechnology Process Engineering Center, the Technology Licensing Office, and private industry.

Of course, the centerpiece of Technology Day will be the luncheon at which the major reunion classes announce their fund-raising achievements. For many alumni/ae, this will be their first opportunity to meet MIT's new president, Charles Vest.

Technology Day materials are mailed to members of all the quinquennial reunion classes and alumni/ae in the Northeast. Anyone who did not receive registration materials in the mail may call Alice Hemphill at 617/253-8233. □

At the time I registered in ProNet I was not actively looking for a position. However 4 months after I registered, I was introduced to a surprisingly good opportunity, which resulted in my present new job. I think ProNet is a great idea, I was pleased with the service, and I would definitely recommend it.

Alan Wadsworth '82

Whether or not you're currently looking for a job, people do make offers you can't refuse. The MIT ProNet service is designed to keep you abreast of challenging opportunities in a variety of fields, including: High-tech, Venture Capital, Fortune 500, Start-ups, Bio-tech, Aerospace, and many more.

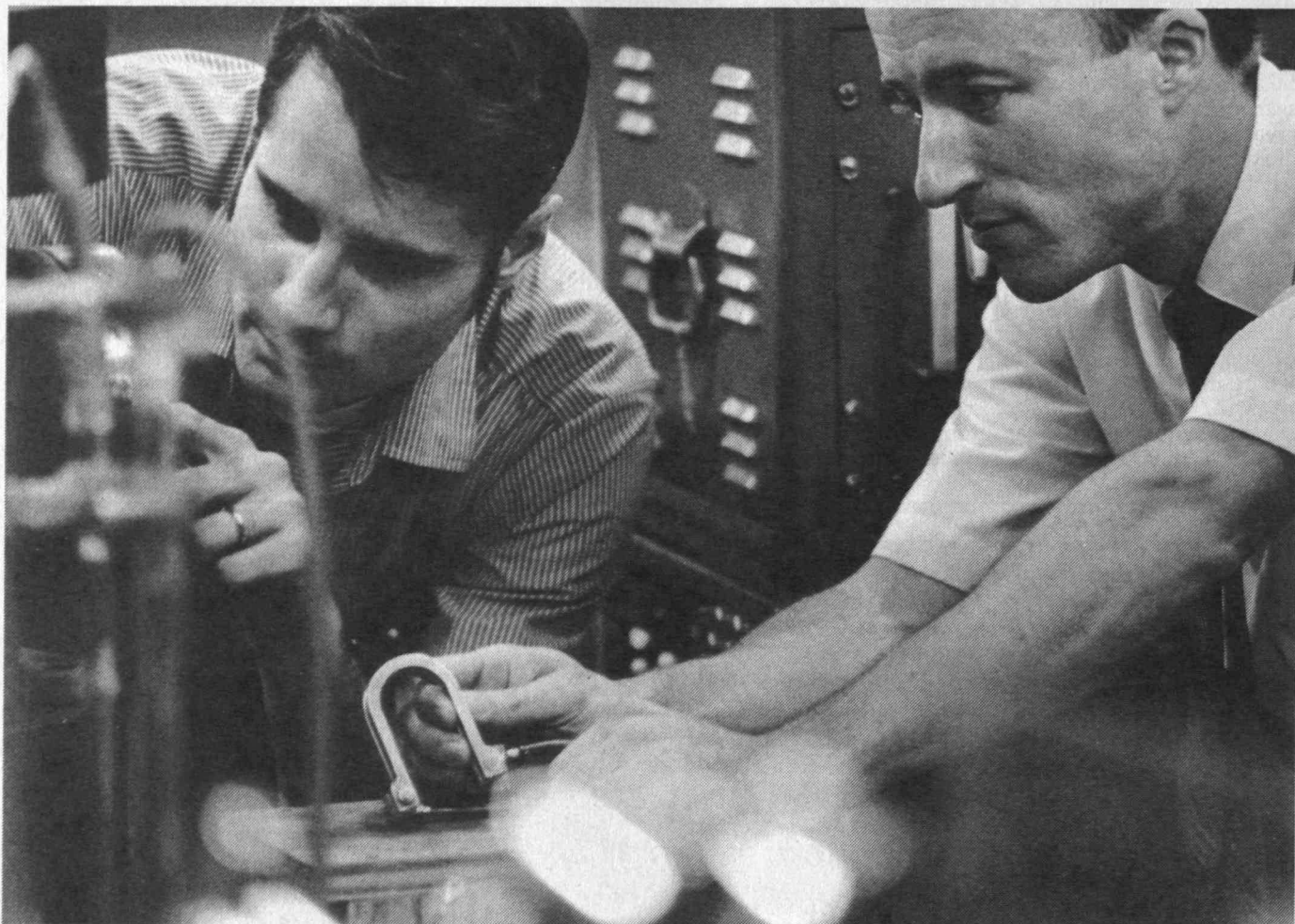
It's easy and it's confidential. For more information write: MIT ProNet, Registration Department, MIT Alumni Association, 77 Massachusetts Avenue, Cambridge, MA 02139.

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America's Perestroika

Living a New National Agenda

By Prof. James R. Melcher, PhD '62



On his bike
and in his lab,
Melcher
fought energy
dependence
and militarism.

Jim Melcher died on January 5 after a six-month battle with cancer. He was the Julius A. Stratton Professor of Electrical Engineering and Physics in EECS and the director of the Laboratory for Electromagnetic and Electronic Systems. He was author or co-author of four books, named on 12 patents, and the recipient of many prizes for his teaching and journal articles. He was a persistent advocate of engineering and science in the service of human needs, high standards of professional integrity, and personal responsibility on social issues. In October, knowing his disease had the upper hand, Jim pulled

Jim Melcher (right) working with Thomas Jones, '66, on Jones' doctoral research in electrohydrodynamics.

all the threads of his career together in one final, passionate essay. To prepare this shortened version of his piece for publication, the Review worked for a brief time with Jim, and after he died, with his wife Janet, daughter Jennifer '83, and colleague Markus Zahn, '67. The article paints an awe-inspiring picture of an engineer fully engaged with his country and profession. -Ed.

For months, the world's attention has riveted on events unfolding in the Persian Gulf. As I followed those developments, I was also learning in stages that I have advanced colon cancer, a fact that could be expected to engender an apocalyptic view of the state of our nation. So could my all-season bicycle commuting, beginning 17 years ago with the first Arab oil boycott. One and a half hours each day contemplating our transportation system from the point of view of the lowest class on the road brought this country's energy choices into sharp focus.

This commentary is an attempt to portray the degenerate de facto energy policy of the United States for what it is and suggest changes that could preserve what is essential in our way of life.

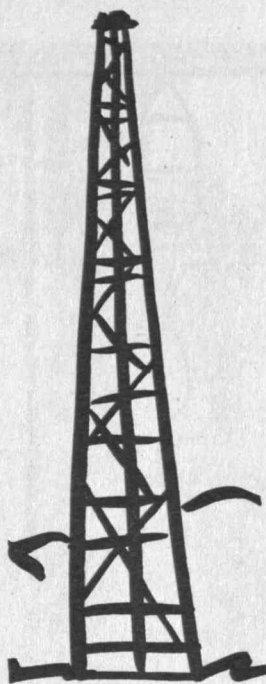
It is also an attempt to achieve personal reconciliation. At 54, my years of life expectancy have suddenly been replaced by months. The resentment I feel for having to distill my time with family and friends is nothing compared to my feeling of alienation from my country, culture, and religion for allowing us to arrive at the present impasse.

In a sense that biblical prophets would understand, many of us are in need of a reconciliation with our fellow citizens, many of whom spent the 1980s burning the national candle at both ends. Even now, these people are not entering the '90s with a resolve to pay past due bills, but rather with angry resentment at a diminishing standard of living. As we now find ourselves being sucked into a Persian Gulf war, I see both the time for my reconciliation and the time for America to make some fundamental changes running out.

Are recent events in the Middle East, together with some understanding of our economic state, enough to convince Americans that there is innate in our system a cancer that must be dealt with? What personal experiences would inspire people whose expectations were inflated by the good times of the '80s to make the sacrifices necessary to preserve a heritage for their children?

Months of Revelation

My years of bicycle commuting ended with a good ride home for the weekend of July 8. This was about when the U.S. ambassador in Baghdad was informing the Iraqi government that we were not interested in their border dispute with Kuwait. It was just prior to the time when Saddam Hussein accused Kuwait and the United Arab Emirates of reducing oil prices and Iraq's income by flooding the oil market.



Maybe

*scientists will
discover
how to run cars
on water,
but let's not
plan our
children's
future around
that hope.*

I awoke Saturday night experiencing an ominous pain in my lower right abdomen. Using CAT scan and ultrasound over several painful days, doctors at nearby Symmes Hospital determined that my right ureter was blocked, and my right kidney could not drain into my bladder. Maybe it was a kidney stone, or perhaps a congenital twist in the ureter, that caused the blockage. Most likely the rumblings from Saddam were no big deal either.

The blockage was found to be too severe to clear from the urinary tract, so a tube was installed to drain the right kidney and relieve the symptomatic pain. All this while, Kuwait and the UAE were trying to accommodate Saddam by reducing their production levels, only to be faced with new demands and further threats of war.

By July 25, Washington leaked plans for military cooperation with the UAE, and an Iraqi force five times the size of Kuwait's army was massed at their border. My medical situation also intensified: I underwent exploratory surgery that entered my right kidney through my side. While I was still under post-operative sedation, my sobbing wife, Janet, whispered in my ear that what had pinched off my right ureter, yet dimly seen, was a malignant tumor. To prevent further blockage, a polymeric tube (stint) had been inserted in the right ureter.

We immediately transferred to Mt. Auburn Hospital in Cambridge, where tests showed that I had an "apple-core" tumor astride the transverse colon, with the duodenum also involved. As the threat to my body was coming into focus, I could see on my hospital TV that so also were the intentions of Saddam Hussein. In short order, Iraq was astride Kuwait and threatening Saudi Arabia.

Because of its involvement with several organs, the tumor itself was inoperable. But another operation was necessary. The surgeon created bypasses around the duodenum and a portion of the colon, isolating the tumor so that it could be attacked with radiation and chemotherapy and preventing it from choking off the gastrointestinal tract. For the first time, the surgeon saw the tumor directly. "About the size of a peach," he said.

Meanwhile, the president was moving aggressively to isolate Iraq. By air and sea, U.S. troops and arms were being poured into Saudi Arabia. Working through the United Nations, Bush won support for a blockade.

Bush hoped an attack would not be necessary; my doctors harbored no such illusions about my cancer. After more than two months of reconnaissance and defensive moves, they were ready to go on the offensive. "Casual-

ties" were expected: radiation promised to also kill my right kidney. When they found a hint of possible infection in the left kidney, shortly to be my only kidney, the first radiation session was canceled. The next weeks doctors spent not in attacking the cancer but in further reacting to its damage.

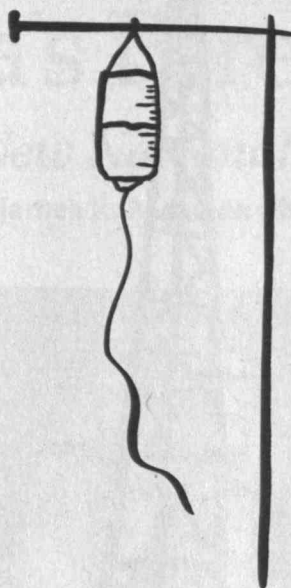
A nephrostomy tube was inserted into the left kidney and a stint implanted. Again we were positioned to attack, but since the cancer had spread, radiation was ruled out. Although it would have only a superficial effect on the main tumor, chemotherapy was my only option.

At this point, what had been a tenuous U.S. posture in Saudi Arabia—a squadron of F-15 fighters protected by an airborne division—had grown to a force capable of launching an attack to remove Saddam Hussein from Kuwait. Even so, we could only watch as Iraq set out to eliminate the Kuwaitis much as it had its own Kurdish population.

By then, there also had been time to reflect on the situation that Bush had gotten us into. Clearly a response to the threat to "cheap oil," our military action was tied in dangerous tandem with heightened tension between Israel and much of the Arab world over the fate of the Palestinians. What looked in the U.N. General Assembly like a new Allied coalition between the United States and such Arab states as Syria and Iran could hardly be expected to hold up either in the long haul or in the case of a U.S.-initiated war.

Even in a best-case scenario, in which Saddam Hussein, with his chemical and half-baked nuclear weapons, did pull his troops out of Kuwait, the region would hardly be secure. Considering the precedent of 50,000 U.S. troops still in Japan after almost half a century and 40,000 yet in Korea, surely some U.S. military contingency would have to remain in the Persian Gulf, making further long-term demands on the debt-ridden U.S. treasury. Granted, the secretary of state circulated among our allies to secure financial support for the military service being rendered. But since contributions come largely from the oil-producing states, which meet their commitment through higher prices and increased production, it does not take much insight to see that we are the ones actually paying even the oil producers' share of our military activity in the Middle East.

My experience in coping with a cancer that set its own terms for therapy makes me particularly sensitive to what it means to act from a position of real strength. While it may have looked as if our military buildup in the '80s enabled us to play an appropriate role in



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resisting Saddam Hussein, it is clear that we can only react to crises. Indeed, given the state of our economy, we cannot truly afford to do even that.

The '70s: The Challenge Revealed

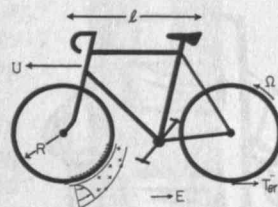
A key experience in my development as an activist engineer was a 1971 sabbatical year at Cambridge University, where I participated in research at Cavendish Laboratory and started writing the text *Continuum Electromechanics*. The turbulent events of that period—with the Americans in Vietnam and British in Northern Ireland—as well as the opportunity to see my country from abroad, set me to searching for ways in which my teaching and research could have a stronger impact on the course being taken by my country. I wanted to influence students to employ basic engineering science to have an impact on the "real world."

Shortly after my return to MIT came the first Arab oil boycott. The lines of cars waiting at the gas stations and my growing awareness of our energy vulnerability led Janet and me to sell our second car. I would commute by bicycle, an 18-mile round trip.

Jimmy Carter's declaration of an energy policy that was the "moral equivalent of war" ushered in important changes. The price of oil peaked at double its pre-boycott level, motivating Congress to fund R&D on indigenous energy sources. Tax incentives were designed to encourage the commercial development of a range of energy alternatives (many of which would have long since been commercially competitive if the price of oil had remained at the boycott level.) The environmental consequences of energy use were addressed, and conservation became a high priority. Automobile advertising switched, for a time, from emphasizing performance to touting fuel economy.

My research turned from demonstrating basic principles to applying them to problems—such as limiting air pollution from diesel exhaust and coal combustors. My graduate students Karim Zahedi, Jeff Alexander, and Peter Zieve were typical: one day they were theorizing about the mass-transfer influences of electric fields on fluidized beds, the next they were applying these ideas in a Brockton, Mass., plant, making the recycling of asphaltic concrete environmentally acceptable.

I became active in promoting bicycling, and for a year or so I represented the Boston Area Bicycle Coalition and the League of American Wheelmen on Beacon Hill, pushing legisla-



Many of the graduate students who did their research in the Laboratory for Continuum Electromechanics, a subset of LEES that was founded by Melcher, were initially attracted by the lab's reputation for cycling zeal. Indeed, the lab's logo (above), was a diagram of a bike. Heading off for a race (left to right) Peter Zieve, '76, Melcher, Richard Withers, '76, Kent Davey, PhD '79, and Alan Presser, '78.

tion concerned with bicycling.

For me those were the days of hope that Americans would step up to the challenges of energy and environment. However, even then I recognized the futility of talking only about sacrifice. Bicycling was fun, and that's the first reason for doing it. Some members of my laboratory got good enough to be competitive. Kent Davey, Richard Withers, and I, for example, were the first-place team in one of MIT's biannual, 30-mile intramural races, in which the average participant's age was about half of mine.

The '70s were also a period when we saw the shah of Iran, being interviewed on a U.S. national news program, look straight at the camera and affirm that he was God. America, whose CIA had played a key role in keeping the shah in power, seemed unconcerned. For those who followed what happened in Iran, Kuwait is a replay. For the sake of oil, our government cast its lot with an obscenely rich dictatorship that was out of step with popular movements. The United States once sold its most sophisticated weapons to Iran in support of the Pahlavi family. Now that support goes to the relatives of the emir in Kuwait and the sheiks in Saudi Arabia, while the poor neighboring Arab states harbor caldrons of popular discontent fueled by the Palestinian cause.

The '80s: Opportunity Squandered

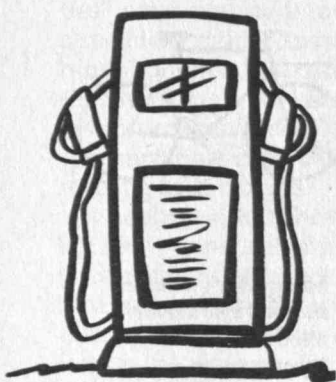
The takeover of our embassy in Tehran and the long hostage crisis demonstrated that the United States had positioned itself to react rather than control. Americans were only too willing to define the Ayatollah Khomeini, not their own dependence on foreign oil, as the growing and real threat. Prior to the confrontation at the embassy, Carter's approval rating was riding high; but before it had ended, the election was over and so was his presidency. In effect, Khomeini had been the deciding factor in the election of Ronald Reagan.

With Reagan came a shift in attitude. Once I might have received a nod of respect when I said I didn't need an MIT parking sticker because I commuted by bicycle. In the '80s, the same remark elicited the supercilious smirk of someone discerning a sucker. The American flag flew in its glory to advertise used car lots but not to protect minority views. TV evangelists used the cross of Christendom to exalt materialism and personal wealth, with a militaristic bent that had little to do with the teachings of Christ as taught to me by my preacher father.

Citizens no longer asked what they could do for their country; they exuded distrust of

T₀

*integrate your
values with
the way
you earn your
living is
the true test
of an
education.*



government and took pride in demanding that there be no new taxes. The share of existing tax revenue that went to support a bloated military kept growing. With states like Massachusetts competing for lucrative military contracts paid for by funds borrowed from abroad, the military became the engine of an illusory economic well-being.

I watched the effects of military spending in the power-apparatus industry. In 1987, GE closed its large transformer facilities at Pittsfield, Mass., and sold the rights to the technology to its chief domestic competitor, Westinghouse. Then Westinghouse in turn sold its large transformer business, an area where the Japanese were already strong, to Europeans. In the 1990s, the United States faces a period of expanded capital acquisition by the electric utilities, and our foreign competition will reap the economic rewards of meeting our most basic energy and associated environmental needs. In the meantime, GE has hung on to its profitable ordnance manufacturing operation at Pittsfield, and that community has come to realize how vulnerable its economic base is to any change in military procurement.

Throughout the decade, there were certainly enough indications that the country was in trouble, even in a conservative publication like the *Wall Street Journal*. On October 9, for example, the day of my second chemotherapy session, a *WSJ* article outlined how the continual increase in indebtedness since 1983 now meant bankruptcy for many American firms drawn into the junk bond vortex.

Many of my talks in the past five years were illustrated by graphs from the *WSJ*, all showing the precipitous march toward trouble that began around 1983. One from January 3, 1990, shows that the public debt, which had held level at about 140 percent of GNP, started an upward ramp in 1982, to reach more than 180 percent by 1989. A *WSJ* article on September 18, 1987, showed that in 1982, Americans had \$137 billion invested overseas. Just four years later, the flow was reversed: foreign investment in the United States reached \$263 billion.

As we entered the '90s, each discovery of another debt engendered during the Reagan years seemed to numb our sensitivity to the previous revelations. The misappropriation of superfunds by EPA officials was eclipsed by the revelation that it would cost an estimated \$130 billion to clean up sites poisoned in the production of nuclear weapons. The costs in terms of public confidence in government, as citizens learned how their exposure to radiation had been covered up, could not be quan-

tified. Then there was the HUD scandal, where the acknowledged waste of \$2 billion in tax funds again barely reflected the cost in public confidence. Now all of this is overshadowed by the S&L fiasco, with its latest estimated price tag of more than \$160 billion.

More insidious because less visible was the rotting of infrastructure. Roads and bridges that should have been maintained by revenues from the gasoline tax were allowed to decay. Acid rain was put on a "study now, pay later" plan, and the AIDS and drug epidemics were similarly given head starts that would cost dearly in the future. State and local governments, under growing pressure to pick up the responsibilities shunned by the federal government, found themselves confronted by the same "no new taxes" attitudes honed by Reagan—hence, had no resources for coping with the worsening K-12 educational crisis. And most corrupting, more of a time bomb than a mortgage on the future, was the increasing gulf between rich and poor.

A Beaver Speaks Out

In October I spent a few hours on Mondays at Mt. Auburn hospital, plugged in for IV delivery of 5FU and Leucovorin, while Janet read me a book about MIT's remarkable mascot, the beaver. Perpetually at work on the domed lodge where they nurture their young, beavers have an equally admirable maintenance program for the dam. If the water level drops, the lodge is no longer secure, so beavers will even tear down the lodge to provide materials to mend a break in the dam.

I had been thinking for some time about another kind of beaver—those driven, productive MIT faculty and their intellectual progeny. I pictured the domed lodge of MIT looking out on the Charles River and indeed on a "pond" that is our nation's economic environment.

How should these beavers react when they find that their work under the dome is fulfilling and consuming, but the value of that work is leaking away in a hemorrhage in the national economic and industrial environment? Should they try to save the pond? In other words, should MIT faculty enter the public policy debate? I don't think they have a choice: if the United States becomes a second-rate industrial power, Harvard might still be Harvard, but MIT will be a very different institution.

In my own attempts to participate in the policy debate during the '80s, it was important first of all to do the best possible job as professor and lab director. I finished the graduate

You
only had to
read the
Wall Street
Journal
throughout
the '80s to
know that the
U.S. was
in trouble.

text *Continuum Electromechanics* and wrote, with Hermann Haus, an undergraduate text that defined a new approach to teaching electromagnetic field theory. With Mark Zahn, I made a series of widely subscribed videotape demonstrations to go with the undergraduate text.

With my students and laboratory colleagues, I conducted industrially sponsored research on problems like cleaning low-sulfur coal ash from the stacks of midwestern utilities, improving toners for electrophotography (photocopying), minimizing hydrocarbon pollution in automobile painting operations, and developing sensors to monitor power system transformers. Altogether, while distracted by Reagan's reign, I managed something like five patents and 30 journal publications.

As an administrator, eternally wiping noses and trying to make financial ends meet, I encouraged individual faculty, staff, and students to meet the test of problems framed by human needs rather than technical frontiers. I tried to teach by example the art of financing graduate education by designing research to attract industrial sponsorship while also advancing the engineering sciences.

In 1985, the MacArthur Foundation provided a grant to MIT for disarmament studies, and faculty were invited to submit proposals to an Institute committee. With Richard Tabors, who would provide the expertise in economics and energy policy, I proposed to develop a set of national policies that would foster socioeconomic conditions that in turn would minimize the incentives for arming.

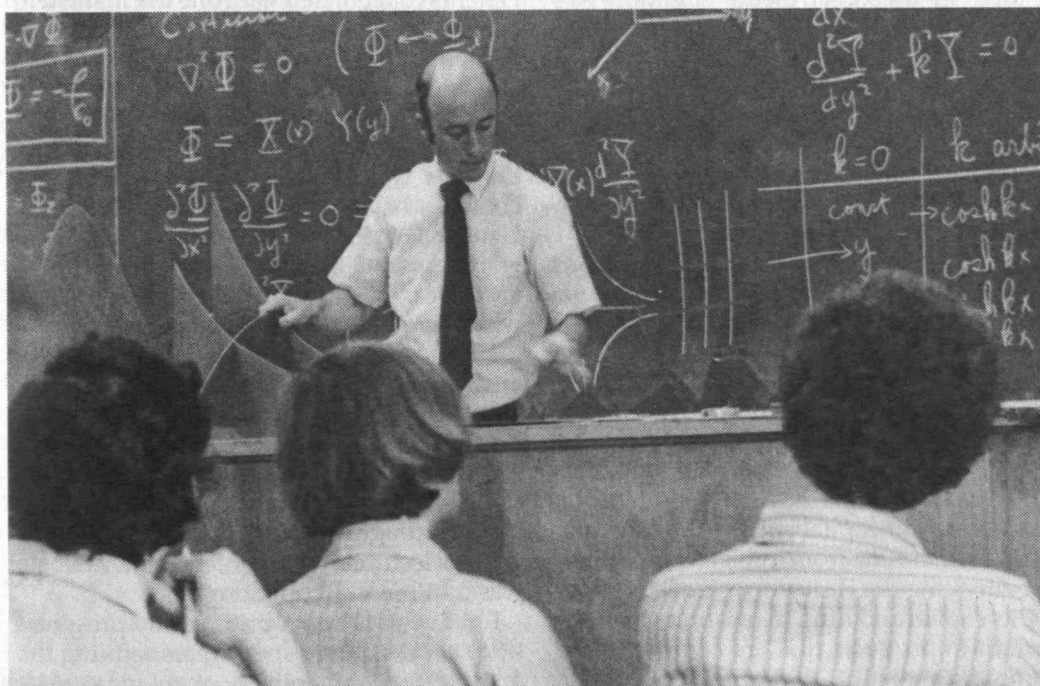
Present policies do the reverse: gasoline is cheap because it is subsidized through taxes for the military, so people see arming as being in their economic interest.

Tabors and I proposed to explore ways of restoring free-market incentives by having consumers pay the true cost of oil. A tax could be levied on imported oil and revenues earmarked to pay an appropriate portion of the military budget. Income taxes could be cut by an amount equal to the revenue raised from the import tax.

Without a hidden military subsidy of foreign oil, domestic energy sources would be competitive. Embedded in shale, for example, there is more oil in the United States than in the Middle East. Shale oil would be competitive if the price of imported oil were little higher than it is now—and if that price held steady as crises came and went.

Even such a limited restructuring of the American economy would require measures of Byzantine complexity. It would be necessary to protect low-income groups from an unfair burden, create disincentives for industry to move manufacturing overseas, and protect the development of indigenous energy supplies. Such a program would have to be implemented on a firm schedule over a long time, to allow businesses and individuals to reorder a way of life based on apparently cheap energy. The complexity of a corrective taxation system points to just how profoundly our current system of military subsidization distorts our way of life.

How
should MIT
faculty react
when national
policies
threaten the
economic
and industrial
environment
in which their
work is
embedded?



Melcher was known for his demonstrations—later videotaped to accompany a text he co-wrote—for 6.013, *Electromagnetic Fields and Energy*. Here he uses models to explain Laplace's equation.

The talents of my own laboratory were ideally suited to SDI research, but I succeeded in finding alternative funding.



For whatever reason, the MIT MacArthur grant committee turned down our proposal. Surely now, as the U.S. reliance on foreign oil climbs from the 1985 level of 30 percent to the current 50 percent, the proposal would receive a more favorable review.

For me, the political corruption of our free enterprise system and our real security interests came to a head in March 1983 when Reagan announced the Strategic Defense Initiative, or Star Wars. Although almost everyone agreed that SDI was as much a political initiative as a technical one, academic research organizations were divided as to how to react. In response to blundering Pentagon efforts to make university pursuit of SDI funds look like endorsement, President Paul Gray was particularly vehement: "Not so."

The talents of my own laboratory were ideally suited to SDI research, and I made it clear that I would not block any proposals for SDI funding from individual faculty. But I did everything I could to find alternative sources of research support, and I was proud of the results.

Personally, I wanted to take a stronger position, and on May 13, 1986, I joined with three Nobel laureates at a Washington press conference to make public 3,700 pledges to not take SDI funds. We represented professors and senior researchers from 109 universities and research centers. I myself enlisted the participation of many of my colleagues at MIT. At the time, media attention was focusing on whether SDI made technical and political sense, and they ignored the "engineer's" press release that I handed out. The *Wall Street Journal* editorialized that week that we were "Intellectuals in Isolation," and even declined to publish my news release as part of a letter to the editor. But now it can be seen as prophetic:

"We have no meaningful defense without a healthy economy. The dollars we spend for SDI are from a deficit budget. Pursuit of SDI implies even larger contributions to the deficit in the future. This alone puts our economic future in jeopardy. But, as our balance of payments becomes increasingly negative, it becomes more evident that military spending compounds the economic tragedy by suffocating our capitalistic base. Our industry can either hide from foreign competition by cultivating the Pentagon as a customer or use its capital and human resources to make a profit in products that are competitive at home and abroad. . . While SDI escalates the

confrontation with our military adversary, it makes us even less able to compete economically with [allies] who do not share our obsession for arming."

My chemotherapy went well until the fourth weekly session, which had to be put off because of debilitating side effects. That was the week Gorbachev received the Nobel Peace Prize. Is it true, as Reagan would claim a few weeks later, that SDI caused the USSR to rein in its military aspirations? To believe that the Soviets would react to anything they perceived as superior military technology by laying down their arms is to forget that these are the people who turned back Hitler at Stalingrad. Gorbachev was, indeed, compelled to embark on his perestroika, but it was by an economic and not a military threat.

We delude ourselves, however, if we think that it was simply Marxist economics, the inadequacies of a controlled economy, that were the undoing of the USSR. If the United States remains as overcommitted to military spending as the Soviet Union once was, we will share their economic fate.

Keeping the Faith

Much as I have tried to restrict arguments for an American perestroika to matters of economics and common sense, I experience the basic issue as moral. I tried to express my concerns through my involvement in the Methodist Church. In the summer of 1986, my church in Arlington Heights collaborated with one in Pittsfield to sponsor a resolution by the Southern New England United Methodist Conference opposing militarism and promoting conversion from defense technology and jobs. With military chaplains sitting in the front row while the vote was being taken, and pastors of churches having congregations working for General Dynamics, GE-Lynn, and Raytheon worrying about a further loss of membership, it was clear that the consequences of militarism were being made local and personal.

I found myself more and more pulled into an activist role during the '80s, but giving invited presentations at MIT and across the country always left me feeling inadequate. Part of my discomfort stemmed from sharing the podium with practiced speakers who gave thoroughly inspirational as well as insightful lectures. For them, the policy debate was a fulltime occupation.

I had always taken pride in my presentations as a teacher. I spent years refining the organization and delivery of my ideas. As a

teacher, I also knew how to critically grade myself for impact on an audience. My experiences in the policy arena were very hard on my teacher ego. In that sense, I took a beating, not a trip.

But, in looking back, I also realize that there was something different about my activism that would take its toll. I internalized the issues, both at the institutional and the personal levels. In public presentations, and perhaps more importantly in innumerable group and individual discussions, I was trying to understand how to make America's perestroika an integrated part of my existence. This demanded a serious commitment and generated stress in my relations with people who meant the most to me—faculty and staff colleagues, students, and some members of my church. I was also frustrated by the difficulty of communicating what I was learning to those outside my profession and MIT.

For all that, I believe that engineering is a strong base from which to counter a degenerate tide in human affairs. Because it is so thoroughly tied to industry, the profession can be independent from misguided government policies. This realization flooded over me while I was addressing a group of mathematicians meeting at the University of California/Berkeley to consider the pros and cons of accepting SDI support. Cultivating a synthesis of mathematics with civilian needs would give them some control over the social impact of their work, I argued. It was the middle of the night Boston time, so maybe I wasn't as persuasive as I might have been. But the blank expressions on the majority of faces left me feeling that the real problem was that this audience, intelligent as they were, saw industry as a distraction from their basic frontiers.

To really integrate the way you earn your living with your social and even spiritual aspirations, for people in any line of work, is the true test of an education. Your values must become part of your professional thinking, which is best learned "hands on." It saddens me to know people who are paragons in their professions, can knowingly discuss the arts in several languages, are abreast of current events, are even religiously active, and yet who pursue their life's work without this integration.

When I have to tell someone that I have cancer and things don't look so good, I often find myself listening to "the doctors were wrong"



It is
with envy
that I see
others still
able to fight
the battle
for America's
perestroika.

stories—accounts where miracles interceded or new "just in time" cures were found. While accepting these as messages of support, I am struck by the denial they communicate. My recognition of my state of affairs does not mean that I have lost hope. But it makes little sense to plan what time I have left with the idea that in the end something unforeseen will save me.

Similarly, of all the painful truths that America must face, its need for energy independence is one of the most basic. Maybe there is more oil in Alaska; maybe scientists will learn how to run automobiles on water. But let's not build our children's futures on these hopes. As our energy needs pull us toward combat in the Persian Gulf, we should be seeing more clearly the consequences of having lied to ourselves about the need for Carter's "moral equivalent of war."

In 1940, my uncles were the same age as my current students. The world they contemplated was also threatened, albeit by different forces than the ones we face in 1990. Hitler had already ravaged Europe, as had Tojo the Asian mainland, and yet America was reluctant to be drawn into the war. It took Pearl Harbor to galvanize the public.

I shudder to think what it might take to rouse Americans today. With each day, the United States is experiencing the erosion of its own capacity to take positive action. Like cancer, the two-headed Hydra of energy dependence and militarism is so devastating because it takes so many forms, each adapted to a particular weakness in the system. The Persian Gulf confrontation is doubly tragic because it perpetuates the notion that the real threat can be dealt with in military terms. A military that responds to the needs of a society with its parts in balance is a noble institution. But as an organism that reaches into all parts of our national life, like cancer taking on a malignant life of its own, beyond our means to sustain, it becomes the enemy.

In 1940, my uncles faced at best an insecure future, and I feel anguish and envy when I think of them: anguish that they suffered the horrors of war, but envy because their battles would be celebrated in America for the next four decades.

In contemplating the lives of those who choose to fight for America's perestroika, I have the same mixture of feelings. It is with sadness that I see our having come to such a weakened state, especially since it could have been avoided. It is with envy that I see them still able to fight in this, the most important battle in our nation's history. □



CLASS NOTES

11

We are sorry to report that **Morrell Mackenzie**, former vice-president and director of the Sayles Finishing Co., died June 5, 1990, at age 100 in Providence, R.I. He was a senior member of the deaconate of Central Congregational Church, a Mason, a Shriner, and a member of the Anawan Club. He retired in 1956 as manager of the former Glenlyon Print Works and had also been a director of the Rhode Island Insurance Co., an executive operating trustee of the First National Petroleum Trust, president and treasurer of the Reeves-Ely Laboratories, N.Y., and president of the William Schollhorn Co., New Haven, Conn. He leaves a son, Cameron Mackenzie of Hingham; a daughter, Elizabeth M. Jordan of New Canaan, Conn.; six grandchildren; and nine great-grandchildren.—ed.

13

At age 101, **Thomas J. Lough** died of heart failure last October 9 in his Grosse Pointe, Mich., home, where he lived with his daughter and son-in-law, Evelyn and William Montgomery.

After earning a degree in civil engineering from MIT, Lough spent 14 months in France as a commissioned officer in the U.S. Army Engineering Officers Corps. during World War I. He married Genevieve Simpson in 1920 and worked as a civil engineer in Canada, North Dakota, Iowa, Nebraska, and Missouri before moving to Michigan in 1927. He became general manager of Thomas H. Stephens, Inc., a real estate holding company that constructed many gas stations, supermarkets, and commercial buildings in the Detroit area.

During his long life, Lough was known as an able investor and businessman, and as a golfer and musician, with a beautiful tenor voice and a talent for playing the clarinet. A widower in 1978, Lough moved to Grosse Pointe, where he was a member of the Grosse Pointe Senior Men's Club, and he played duplicate bridge there twice a week. He is survived by his two children, Evelyn and Thomas, eight grandchildren, and ten great-grandchildren.—ed.

14

Unfortunately, we have three deaths of classmates to report: **Maurice T. Root**, MD, of Rockland, Maine, on April 23, 1990; **Victor C. Brownson** of Holland, Mich., on June 29, 1990; and **James B. Reber** of Johnstown, Pa., on November 25, 1990.

After graduating from MIT, **Maurice Root** went on for an MD from Cornell University Medical College. After completing an internship at Bellevue Hospital in New York City, he was an assistant professor of hygiene and preventive medicine at Cornell University. In 1922, we went into general practice in New York City and then West Hartford, Conn., until semi-retirement in 1967. He was a physician to the American School for the Deaf, a lecturer at the School for Social Work at the University of Connecticut, and senior surgeon in reserve of the U.S. Public Health Service. He was a longtime attending physician and later consultant at Hartford City Hospital and a senior physician at Hartford, Conn., Hospital. He

was past president of the Hartford County Medical Association and belonged to numerous professional organizations.

Victor Brownson was a retired deputy engineer for the New York City Water Works, where he helped design the city's famed Holland Tunnel. Completed in 1927, the 1.6-mile-long, twin-tube tunnel, which runs 93 feet beneath the Hudson River and connects Manhattan with New Jersey, was the first long-distance underwater tunnel made specifically for automobile traffic in the world, according to the *Encyclopaedia Americana*.

After graduating from MIT, **James Reber** was employed at Columbian Rope Co. until retiring in 1947. He continued as director and consultant until 1960 and was also director of associated industries in New York State. He was active in many social and civic organizations.—ed.

17

Enos Curtin kindly brought us up-to-date in a letter the end of November—too late for the February/March issue of the *Review*. Although this is being written in 1990, I regret, Enos, it will not appear until April.

Enos is now letting the younger generations take over most of his volunteer activities. He recently resigned from the American Field Service (AFS) after 75 years of close affiliation, starting as an ambulance driver (as I recall, in December 1914). Enos can be justifiably proud of his important role in the AFS Intercultural Program. It began with 17 teenagers in 1947 and now numbers in excess of 9,000 in countries including China and the USSR.

All this is not to imply that Enos has become inactive. Last May, he spent a very pleasant two weeks in New Zealand, which he found to be a fabulous country. In July he spent a couple of weeks in Utah, Nevada, and New Mexico visiting relatives and riding—a far cry from the average life in New York City. And when he wrote us in November, he had just returned from Ireland where he had enjoyed a month in that country's relaxing atmosphere. He found the people prosperous—building new roads, up-grading their cities, and, as he adds, "building antiquities for the tourists."

Few of us can match that for a year in review, but that's no excuse for not sending the news you do have for your classmates, who are anxious to hear about their longtime friends. So, write or call (617 237-9378).—**Don Severance**, '38, acting secretary, 39 Hampshire Rd., Wellesley Hills, MA 02181

18

I sent 1990 year-end greetings to our 21 living class members and am happy to report returns from six and a welcome greeting from **John Kilduff's** widow.

The most interesting news was from **Eaton Clogher**: "Your Christmas card is like the rising sun—sure to appear on time. I trust you and your family are in reasonable good health, spiritually 100 percent. I have been bothered with eye trouble going on 14 months now but pointing toward a reasonable success, two major surgeries. The doctor I have is excellent. After graduating

head of his class in Iran, he came to Johns Hopkins, the first Arab student. My daughter-in-law, a supervisory nurse, drives me back and forth to his office. He realizes I have hearing trouble and talks to her in detail about what he is doing. Last visit I told him I realize I'm a tough patient. He slapped me hard on my knee and said, 'When you show up, you make my day.' So I am patient and thankful.

"The original painting of the picture on this card was made by an artist holding the brush in his teeth, published by the Association of Handicapped Artists, Inc. This association is not a charity group; they are self supporting. Some of them hold the brush in the toes of the foot. Imagine the time and energy! So what have I or any other old age affected persons got to complain about? Nothing on my part, thank God."

Arthur Williams reports a stroke last February but, thank the Lord, has recovered 80-90 percent. Keep up the good work. He includes a substantial check for the MIT fund. . . . **George Halfacre** sends good wishes. He is retired but has lots of memories, particularly of his wife of 51 years, deceased since 1975. . . . **Herb Larner** sends cheery new year greetings and promises news for these notes soon. . . . Greetings arrived from **Eli Berman**, who is now living in Coronado, Calif., and from **Ben Greely**. . . . I was particularly pleased for a cheerful season's greeting card from **Elinor Kilduff**.—**Max Seltzer**, secretary, 865 Central Ave., Needham, MA 02192

19

Allow us to share with you some of the holiday greetings from our 1919 classmates. **Bob MacMullin** and his wife, Olive, sent their annual lively Christmas letter that includes some memories of the past year. It begins with verse: "Let others toot New Year's arrival. We thank the Lord for our survival." Other greetings were received from **Barbara and Don Way**, who also telephoned; from **George Michelson**, who was delighted to receive a card from **Leo Kelley**; and from **Erma and Doc Flynn**, who wish us good health and happy days in spite of the encroachment of years.

A newspaper clipping advised us of the death on September 8, 1990, of **Joseph Elliot Cannell** at his residence in Kennebunkport, Maine. Cannell graduated as an electrical engineer. He was an army veteran of World War I and was employed for 35 years by the New England Telephone Co. as an electrical engineer. He is survived by his wife, Wanda, of Kennebunkport; three daughters, **Barbara C. Manning** of Vestonia, Ala., **Wanda P. Cannell, Jr.**, of Kennebunk, and **Pamela E. Peterson** of Menlo Park, Calif.; a brother, **Phillip S. Cannell** of Coral Gables, Fla.; seven grandchildren; and six great-grandchildren.

Our class of 1919 has a savings account of a little over \$1,000. President Way and your secretary thought it would be appropriate at this time for the class to make a gift of \$900 to the MIT Alumni Association to use as they deemed best. This action will be taken in the next few days.

Although you will be reading this column in April 1991, we are preparing them in December 1990, so we hope the new year will smile upon you.—**W.O. Langille**, secretary, P.O. Box 144, Gladstone, NJ 07934

Harold Bibber, of Columbus, Ohio, died last November. He was chairman of Union College Engineering Division and headed the Electrical Engineering Department during World War II. He helped bring the Navy V-12 education program to Union. Early in his career, he joined General Electric and was assigned to its Tokyo office. He later returned to Japan and served as guest lecturer on engineering education at several Japanese universities. Upon his return, he moved to Columbus. He was a life fellow of the Institute of Electrical and Electronics Engineers, a member of the American Association of University Professors, and the Torch Clubs of Schenectady and Columbus. He leaves his wife, two daughters, a son, and four grandchildren.

Rear Admiral **Donald Royce** of Falls Church, Va., died last October. . . . **Rostislav Nebolsine** of New York City died last September 16.—**Harold Bugbee**, secretary, #313 Country Club Heights, Woburn, MA 01801

70th Reunion

It's a snowy morning three days after Christmas as these notes are being written. I had a nice long Christmas letter from Emma **Lloyd** in which she tells me she had a very happy year—visited colleges, attended a grandchild's wedding, and saw her first great-grandchild. She has traveled around the country a lot this past year and still volunteers once a week at the local hospital.

A letter from Betty **Patton** says she also does volunteer work four days a week at the adult day care center. She took one-day trips to the Kutztown and Bloomsburg Fairs and healthwise is in the "pink." . . . **Celia Huggins** says she is healthy and has traveled around Florida this year on a few trips. . . . **Helga Parsons** took a brief trip to the MIT campus this past summer and was "deeply impressed." She now lives in Florida year-round.

Cards were also received from Dorothy **Wenick**, Maxine and **Cac Clarke**, Claudia **Crosby**, and Helen **St. Laurent**. Your secretary also phoned the **Clarkes** and Helen **St. Laurent**. The **Clarkes** expected to get together with family for Christmas. Helen says her past summer at Center Lowell, Maine, was wonderful.

Two deaths were reported this month: **Llewellyn B. Griffith, Jr.** of Austin, Tex., on September 27, 1990, and **Francis D. Holmes** of Henninger, N.H., on October 12, 1990. Holmes died from injuries when he was hit by a car near his home. In 1925, Johns Hopkins University awarded him a Doctor of Science degree. Holmes made a specialty of studying the mosaic virus diseases of plants and developed varieties of tobacco, tomatoes, and sweet peppers resistant to mosaic virus disease. He was the first to discover the one-celled animals called herpetomonad flagellates living in milkweed plants.—**Sumner Hayward**, secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA

Crawford H. Greenwalt, honorary chairman of the board of Du Pont, was awarded the Benjamin Franklin Medal by the American Philosophical Society at the society's autumn general meeting held in Philadelphia last November. This society, founded by Benjamin Franklin some 250 years ago, is said to be the country's oldest and most prestigious general learned society. The award recognized Greenwalt's "significant contributions to high pressure synthesis of ammonia and the miracles of technology that brought nylon to the market; of wide-ranging scientific accomplishments, in particular his study of the flight and

habits of hummingbirds; and especially for his vital role in the development of nuclear energy." Greenwalt has been a member of the society for 36 years and has served as its president.

LaMonte Griewold, who was with us only through freshman year, is still in good health at 92 and living in Sudbury, Mass. He is going for 102, which will make him one of the few who have lived in three successive centuries. . . . **Edward J. O'Connor** is still enjoying retirement with a little golf (9 holes now). He says he has shot his age if it is okay to multiply his 9-hole score by two. He has two sons running successful businesses, one a contractor and the other a construction machinery dealer. . . . **William A. "Bill" Tripp** and his wife, Daisy, are still living in Sarasota in their house bought 16 years ago. Arthritis ended his golf. Duplicate bridge is now his major competitive sport. . . . **Bill Elmer** suffered a broken leg when hit by a car while crossing a dark street near his home in Andover last December. Recovery proceeded nicely.

Arthur L. Bennett, age 90, died November 4, 1990, after an extended illness, in a nursing home in Newburyport. He is survived by two daughters and nine grandchildren. A son predeceased him. . . . **Allan Wescott**, at age 92, died December 13, 1990, at his residence in Belle Haven, Va. He had a successful and extended career with General Motors as the director of parts and service for both the U.S. and export divisions. At the beginning of World War II, he returned from overseas to head parts and service for Eastern Aircraft and served on the President's War Production Council. Retirement came shortly thereafter. He is survived by his wife, two daughters, one son, and nine grandchildren. . . . **James W. Kinnear, Jr.** died September 14, 1990, at age 92, in Birmingham, Ala. He entered MIT as a junior after graduating from Allegheny College. He had a long and successful career in the steel industry starting in 1923 with U.S. Steel at the Homestead Works in Pennsylvania. In 1947, he became president of Firth-Sterling Steel and Carbide Co. and went back to U.S. Steel in 1951, from which he retired in 1963. He is survived by his wife of 68 years, Susan, two sons, and a daughter.

Our condolences are extended to the families of these deceased classmates.—**Yardley Chittick**, secretary, Rt. 1, Box 390, Ossipee, NH 03864

Our president, **Royal Sterling**, reports on an extended trip with Mary to Rhode Island, then up to New Hampshire where he spent ten days and had more than his fill of lobsters, a true New Englander. On the way back, he stopped again in R.I., where he celebrated his 90th birthday with a host of friends. . . . **Miriam and Dave Joy** have succumbed to a retirement housing complex with all the desirable facilities. Several of their close friends are in the same complex. It is very likely a smart move. Should friends wish to get in touch, the address is: 8400 Vamo Rd., Apt. 665, Sarasota, FL 34231. . . . **Dick Frazier's** wife, Elizabeth, has written a book under the name of Elizabeth Howland, entitled *Stevan*, about communism in Yugoslavia and life in the U.S. at a university. It will, hopefully, be published in April.

A long letter arrived from **Bill Lalond, Jr.** He was with us in the summer of 1921 at the camp in East Machias, eight weeks of fresh Maine air to get Courses I, III, X, and XV ready for the next grind at the Institute. Those were glorious days. No one got hurt, miraculously, chopping brush for surveyors, or drowned doing stream gauging. Bill will be 91 in February, and Marion 87 in January. He's slowed up a bit, but they both drive their cars. They have two daughters who have families who seem to have covered the world. If you would like a copy of Bill's letter, I don't think he would mind.

I rarely write these notes without a bit of sad-

ness. Let's face it folks, most of us are around 90. The other side of the coin is, the Lord has been mighty good to let us see the wonders of His world. . . . A short note states that **Everett E. McKeen** passed away in July 1990. He received an SB in civil engineering and began his career in the Erection Department of the American Department of the U.S. Steel Corp., Pittsburgh, Pa. He was promoted to erection manager in 1954 and in 1958 to general erection manager. Our sympathy goes out to his family. . . . Professor **Feng-Hsiang Hua** died in March 1984. The report was delayed because of a misunderstanding as to who was to inform the Institute. He was in general administration of civil aviation of China in Beijing. We express condolences to Mrs. Feng-Hsiang Hua. God bless.—**Fred Almquist**, secretary, 63 Wells Farm Dr., Wethersfield, CT 06109

The Henry B. Kane Class of '24 awards were presented to alumni at the Alumni/ae Leadership Conference on September 15, 1990. These awards recognize remarkable effort in fund-raising for the Institute. Recipients for 1990 were H. Kent Bowen, PhD '71, Jerry McAfee, ScD '40, and Karl Miller, SM '63. Congratulations!

John H. Walthall reports from Rt. 1, Box 116, Sheffield, AL 35660, that he is still active at age 90 with bridge, dancing, and boating. Our best regards to John. And many thanks for the information.

We received notification of the passing of **Addison K. Willis** on August 19, 1990. His home address was Box 1194, Tryon, NC 28782.

Have a good spring and keep in touch with news of the Class of '24.—Co-secretaries: **Katty Hereford**, #237, Box 5297, Carmel, CA 93921; **Col. I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

One of the pleasures of the holiday season is hearing from people associated with the Class of 1925 over the years. Adele and Ed **Kussmaul** checked in from their winter home in Briny Breezes, Boynton Beach, Fla., and Elinor and **Sam Spiker** reported from their new winter residence in Fox Village, Westwood, Mass. From California came greetings from Lillian **Drew** and Charlotte **Blonsky**. Frances **Stanton** wrote from the retirement home in Chestnut Hill, Mass., where she finds all going well.

Several months ago the passing of **Douglas B. Martin** was reported. Since then some facts regarding him have appeared that may be of interest to classmates. Doug joined the class of 1925 as a sophomore having transferred from Worcester Polytech. His first job was as a sales engineer with the Sullivan Machine Co. in Claremont, N.H. In 1933 he moved to Detroit and joined the Amplex Co., which handled a line of portable air compressors. He progressed with that company and was vice-president in charge of sales when he retired. Although he lived in an apartment, he became an avid gardener after he and several of his neighbors created a World War II victory garden in a corner of his apartment complex. Later in retirement, he pursued his love of gardening by maintaining, at his own expense, flower beds around his apartment. He also enjoyed physical fitness activities and playing golf. He was a 32nd degree mason, a life member of his lodge in Detroit, and a life member of the Players Club of Detroit, where he was active behind the scenes with club business affairs.

The passing of three classmates must be reported. **Rheinhold Hakewessell** died at his home in Duxbury, Mass., on September 4, 1990. In his active years he had been an engineer with the Public Service Electric and Gas Co. of New Jersey. He was a member of the Plymouth County Bee Keepers Association, the Duxbury Rural and

Historical Society, and past treasurer of the Pilgrim Congregational Church of Duxbury. He leaves his wife, Miriam, a son, and a daughter.

Russell S. Grove, Sr., died in Dunwoody, Ga., on August 15, 1990. He attended the University of Missouri before coming to MIT. After graduation he served on commissions attempting to settle the war between Chile and Peru and settling the true boundary between the two countries. Following work for the U.S. Geological Survey and the Georgia Power Co., Russell decided to go into law, obtained a degree from Emory University, and practiced in Marietta, Ga., into the 1980s. He was a member of the Marietta Rotary Club, the Marietta Country Club, the Atlanta Athletic Club, the East Lake Country Club, and other civic and community associations. Also, he was a member of a number of professional societies. Interestingly, Russell served as a snakebite consultant for local hospitals. He is survived by his son, Russell S. Grove, Jr., and two grandchildren.

Joseph Manuele, Jr., died in Irwin, Pa., on February 7, 1990.—**F. Leroy "Doc" Foster**, secretary, 434 Old Comers Rd., Box 331, N. Chatham, MA 02650

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When my wife, Mary, and I were in China in 1983, we met about 20 MIT men in Beijing, one of them being **Shi Jiayang**, a professor at Tsing Huan University. We have exchanged Christmas cards every year since. In 1990, I also received a postcard of a panda in the Beijing Zoo. He notes: "Two months ago, the 11th Asian Games were held in Beijing. Thirty-seven countries in Asia sent 6,000 excellent athletes to compete in the 27 projects. Unexpectedly, the People's Republic of China won 108 gold medals out of 187 items offered. Japan ranked second and South Korea third. Since last June, under the unusual leadership of our central government, we secured a very steady state both in politics and economics. This enabled us to play a key role in industrial as well as agricultural developments during the past one and one-half years and also in the future."

William W. Farr writes, "My wife, Virginia, died August 18, 1990. I plan to stay in our home as long as I am able to. At 87 I still do what has to be done for now."... **Eben B. Haskell** of Essex Conn., died September 17, 1990. He lost his first wife, as I did, married again, and had 8 children, 22 grandchildren, and 3 great-grandchildren. As an electrical engineer, he brought electricity to many people in undeveloped nations all over the world. A great classmate... **Martin Grossman** says, "I returned a questionnaire indicating that I will attend my 65th reunion at MIT next June, God and my weak haunches willing."

Crockett Harrison of Grove City, PA., is at it again to bring his family together. After losing Fanny, he married Imogene, and he is sending out a six-part bulletin on their activities over the past year... **Louis R. Taylor** of Bethlehem, Pa., writes, "We are looking forward to attending the 65th reunion in June and will bring as our guests our daughter, Muriel, and son-in-law, Alan Pense, who is vice-president and provost of Lehigh University. Also in June we are celebrating our 62nd wedding anniversary."—**Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169 (617) 328-1840

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B. Allison "Bud" Gillies died on September 15, 1990, at his home in Rancho Santa Fe, Calif. He was another great pioneering aviator in our class. He began his career by becoming a Naval aviator at MIT in 1924. After graduating in mechanical engineering, Bud served a year's active duty as a pilot on the U.S.S. *Lexington*. He joined Grover Loening Aircraft as test pilot and engineer and four years later began work with Grumman Air-

craft on L.I. He became a director and vice-president in 1938 and served a vital role in the production of fighter aircraft for the carriers during the war years. In 1944 Bud moved to San Diego to head a flight test program for jet-prop fighters at Ryan Aeronautical. From 1946 to 1982, he was active as an aviation management consultant and was a director and executive for a number of companies.

He founded and was chairman of Spectral Dynamics Corp., an electronics equipment firm in San Diego. In 1982, it merged with Scientific Atlanta Corp. Bud and Betty were married in 1930 and together they have shared their love of flying. They have crossed the U.S. on countless flights, flown to Europe in their Beech Baron, and to Canada, the Caribbean, Mexico, Australia, Papua, New Guinea, Japan, and in much of Africa. They celebrated their 60th wedding anniversary in January 1990.

We classmates have spanned the years of the development from the first flight by the Wright brothers to supersonic transport, to the roundtrip and landing on the moon. This was accomplished by the cooperative effort of tens of thousands of engineers, mechanics, and entrepreneurs, as well as test pilots many of whom have lost their lives in flight. Truly an era that will never be repeated.

Our deep sympathy is given to Betty and their family.—**Joseph C. Burley**, secretary, 1 Harbour-side Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

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A highlight of the MIT year was the reception for the new president of MIT and his wife Dr. and Mrs. Charles M. Vest, at the Boston Museum of Fine Arts on November 17, 1990. Representing our class, in place of our recently deceased secretary **Walter Smith** and Florence, was Frances **Donovan** and Roxanne **Jojo** McNamara, a daughter of our first class president **Ralph T. Jojo** and stepdaughter of **Walter Smith**. For this festive occasion, there was a formal dinner, dancing, and a private viewing of "Twelve Centuries of Treasures from Japan"... We have an announcement of the opening of the Garrard Ardeneum, in memory of **Thomas Edward Garrard**, at the celebration of the centennial of the University of Oklahoma at McAlister, Okla. The program for this celebration was the premiere of church music of the Choctaw, Chickasaw, Cherokee, Creek, and Seminole Indian Nations of Oklahoma.

The Emma Rogers Society (an association of women whose husbands were alumni or faculty of MIT), has received a new member **Florence Smith**, who will there carry on her enthusiastic work for our class and MIT. Other active members are **Dorothy Goldberg**, **Marjorie Carvalho**, and **Frances Donovan**.

Harlan Paige initiated a Christmastime get-together that included **Everard Lester**, and your secretary. Harlan and Bea's home is on the rocky shore of Long Island Sound at Branford, Conn. Ev and Louise are still in their home on the wide James River at Williamsburg, Va., although they are preparing to move to a retirement residence in Williamsburg. Louise and I still live in our home in the woods on the shore of Panther Pond in Raymond, Maine.

This year we should be actively thinking about our 65th reunion in 1993. Thoughts and suggestions to your secretary or Class Agent **George Palo**, 211 Second St., NW, Apt. 1302, Rochester, MN 55901 are welcome and requested. Remember those great reunions of the past?—**Ernest Knight**, Secretary, Box 98, Raymond, ME 04071

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Edward R. Godfrey, Jr. of 16 Seaforth Ln., Huntington, N.Y., writes, "My wife, Gladys, has be-

come quite frail in recent months, and I have decided to give up all my hobbies, including sailing, so that I can take care of her. She has taken care of my needs all these years, and I am only too glad to take care of her now."

I have received a number of year-end messages as follows: **Joaquin Llanso** and **Dorothy** of Woodlands, Tex., write, "Best wishes and holiday greetings to you and all our classmates"... **J. Wesley Walters** and **Josephine** of St. Paul, Minn., "With the best of good wishes for a happy holiday season for you and all our classmates"... **Butler King Couper** of Tryon, N.C., "I have always marvelled at the great job you are doing for the class of 1929 as secretary. May the good Lord bless you and yours and keep you in good health and happiness. Best wishes for all."

Received a family group picture of **Paul Donahue** and **Fran** of Nahant, Mass., surrounded with 14 smiling faces captioned "Christmas '89." **Paul** passed away in September 1990. (See January 1991 column)... **W. Gordon Bowie** and **Sally** of Olmstedville, N.Y., write, "We presume you will soon head for Florida to escape the winter. I know you don't like snow and ice; we have about 8 inches of snow. It is beautiful and we love it. I had a brief visit to a hospital recently because of a little problem with my legs. I should know soon if treatment will be necessary. We will look you up if we get your way. Best wishes for the coming year"... **Robert Pride** and **Marion** of North Palm Beach, Fla., sent season's greetings, as well as **Bill Baumrucker, Jr.** and **Doris** of Marblehead, Mass., **Richard Piez** of San Mateo, Calif., and **Frank Mead** of Marion, Mass., and **North Port, Fla.** **Frank** adds, "I may go to an MIT Club luncheon next week"... With his greetings, **Chung Foy Yee** and **Zai Chen** of Worcester, Mass., write, "Hope you are well and your eyes have improved."

From **George J. Meyers, Jr.** and **Barbara**: "We spent two weeks at Bob's on the Eastern Shore, Va., in the fall and spring. The April open house and gardens tour was as lovely and interesting as last year's. We went to see grandson Kris on parents weekend at Norwich University in Vermont. Our longest trip was to Burbank, Calif., Newport Beach, Bakersfield, Albuquerque, N.M., Santa Fe, and back home. At Burbank we visited George's first cousin, **Katherine Wright**. The last time they saw each other was at age 4. Let us pray the good Lord straightens out this mess and we have a safe homecoming of all of our loved ones"... **Harold M. Weddle** and **Esther** of San Diego, Calif., report that their **Rancho Bernardo** (the northern section of San Diego) weather is like Florida, warm and sunny.

Adding his name to a distinguished group of past recipients that include **Thomas Edison**, **Orville Wright**, and **Alexander Graham Bell**, **Hunter Rouse**, of Sun City, Ariz., has been named the 1991 recipient of the John Fritz Medal by the American Society of Civil Engineers. This award, given for scientific or industrial achievement in any field of pure or applied science, was established in 1902 as a memorial to John Fritz, an internationally recognized iron and steel engineer. Rouse won the award for pioneering the application of fluid mechanics to hydraulics. Rouse earned an SB and SM from MIT and later doctoral degrees from Karlsruhe Technische Hochschule and the University of Paris (also an honorary doctorate from the University of Karlsruhe, Germany). He also spent a sabbatical year as Fulbright Research Scholar in Grenoble, France, and four quarters of another year at the universities of Göttingen, Rome, Cambridge, and Paris as National Science Foundation Senior Fellow and many months lecturing on five continents. Rouse retired in 1974 as Carver Professor and dean emeritus at the University of Iowa. Hunter Rouse and his wife, **Dorothy**, have three children and six grandchildren. He is one of our most distinguished class members.

I regret to inform you of the deaths of the following members of our class: **Harold W. Straat** of Rochester, N.Y., June 4, 1990; **John G. Sullivan** of

East Dennis, Mass., September 7, 1990; **John D. Newman**, Boynton Beach, Fla., October 8, 1990. Straat was retired from Bausch and Lomb and was a member of the Masonic Crafts Lodge. He is survived by his wife, Marcelline, two daughters, a son-in-law, and three grandchildren. John Sullivan had been a member of the standing reunion committee for many years representing the Cape area. He spent his entire professional career with the Bell Telephone system, the first 17 years with the New Jersey Bell Telephone and the next 24 years with AT&T, retiring in 1972 as engineering manager of underground construction. He was a member of The Dennis Government Study Committee, the Old King's Highway Historical District Committee, a volunteer at the Cape Cod Hospital for 13 years, and a member of several local social organizations. He was a communicant of Our Lady of the Cape Church in Brewster. He is survived by his wife, Lucille, two sons, one daughter, three grandchildren, and one great-grandchild. Memorial donations may be made to the Cape Cod Hospital Fund, LS 370, Hyannis, MA 02601.—**Karnig S. Dinjian**, secretary, 7161 Promenade Dr. #502, Boca Raton, FL 33433, (407) 395-2890

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This month's longest communication is from **Bill Jackson**, who, as previously noted, is chairman emeritus of Pitt-Des Moines, Inc., builders of the St. Louis Arch. Of particular interest to me was Bill's reference to PDM's involvement in the construction of Biosphere II—a large, completely sealed enclosure, only about 50 miles from our winter home in Arizona, in which a group of scientists will be isolated for an extended period. Although we haven't yet visited the site, our friends say it is most interesting.

Bill lost his first wife, Lucinda, in the summer of 1989 "after 57 years of a delightful marriage," and in October 1990 married Margaret Forester Runette, who lost her husband seven years ago. Peg, as she is usually known, was in his first wife's wedding party, and the two families have been friends for many years. Bill still goes to the office five days a week on a shortened schedule, but has greatly reduced his manifold, previously reported civic activities.

From Yarmouth Port, Mass., **Langley Isom** reports that his 1987 second marriage "has been a great success and we are very happy in our simple retirement life." Langley's physical problems significantly limit his activities, but he still enjoys attending the weekly meetings of the Orleans Coffee Club, a group of seniors that meet "to discuss and settle the affairs of the world." Both the Jackson and the Isom second marriages have produced enlarged families: 6 children and 17 grandchildren for the Jacksons, and 6 children and 14 grandchildren for the Isoms.

We also have a few "mini-items" this month: **Allan McLennan** gave a talk on nuclear power at the October meeting of the Wakefield, Mass., Retired Men's Club, attended by more than 200 members. . . . In August, Marjorie and **George Wyman** moved from their home in Bloomsburg, Pa., to a "garden apartment" in the United Methodist Home Complex in Lewisburg, Pa., where the "accommodations, neighbors, and surroundings are very nice." . . . **Josiah Barrett** has given the MIT Libraries a 1620 edition of Euclid's *Elements*, Books 1-6. This edition has parallel columns of the text in Greek and Latin. It will be the earliest edition of the *Elements* in the MIT collection, which currently includes a 1557 edition of Euclid's *Optics* that also has parallel texts in Greek and Latin. MIT Libraries Director Jay K. Lucker characterizes this gift as "a most interesting and significant addition to our rare book collections."

We lost two more of our classmates in October 1990: **Jim Morton** on the 9th and **George Barker** on the 31st. . . . In reporting Jim's death in Sarasota, Fla., his wife Muriel notes that since

there were no job openings in the aircraft industry for course XVI graduates in 1930, Jim went to Harvard Business School for two years and then "entered the employ of the budding young investment counsel firm of Loomis, Sayles & Co., where he remained until his retirement in 1973, having served Loomis, Sayles as vice-president, director, and a partner." In addition to his successful business career, Jim held a number of responsible outside jobs, e.g., commissioner of the Wellesley Public Works Department, member of the Corporation of Northeastern University, trustee of the Newton-Wellesley Hospital, and after retirement, member of the Sista Key Utilities Authority Board. According to Muriel, "Jim attributed his success in college and business to the extraordinary skills developed in him by professors at MIT, where he really learned how to study, to organize his material, and to think clearly in attempting to solve problems. He has sung the praises of the MIT Engineering Department for these many years." In addition to Muriel, Jim is survived by three daughters and four grandchildren.

George Barker worked for many years for the Van Straaten Chemical Co. of Chicago, and was vice-president and research director at the time of his retirement in the mid-70s. His expertise was in the field of lubricants and surfactants, a field in which he continued to do consulting work after his retirement. The letter from his wife Ida indicates that he died rather suddenly. The Barkers had gone to Fargo, N.D., to visit one of their daughters. On the way home George complained of feeling weak and he died that same evening. In addition to Ida, George is survived by two daughters and four grandchildren.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

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60th Reunion

Unfortunately, I have not heard from many of you about the interesting or amazing or other things that have happened to you—but a few have been a great help, and also there has been work on a program for our 60th reunion. A first meeting of the committee was held October 4, 1990, and the program committee has gone to work. The dates are June 6 to 9, and by the time this note appears you will probably have a copy of the program and I hope you will be making reservations for it. All I will say is that they have done a fine job. One part has been largely influenced by Polly **Germeshausen**, and a fine part it is. Our thanks to her.

Received a short note from Helen, which reported **Edwin Worden's** progress had brought him back home on September 1, 1989. But in the middle of November 1990, Ed's condition took a turn for the worse. So he has returned to the nursing home, and greatly to their (and also our) regret, the prospect is that they will not be able to join us for the 60th reunion.

One of the young men in the law office from which I retired (a Harvard law grad) presented me with a copy of a couple of pages from a Harvard alumni magazine recounting the Harvard-Yale football game, which the writer (a Harvard man) reports was won by MIT—the one in which a mysterious eruption and explosion occurred on the field. The writer explained exactly how it was done, in great detail. A very unexpected source for a very interesting MIT story.

Also have a note from **John Swanton**. His outstanding event of the year was following his dad's footsteps, where he lived with Haida and Tlingit Indians on the Queen Charlotte Islands, British Columbia, and in Sitka, Alaska, 90 years ago and visited them on his honeymoon in 1904. (The senior Swanton was ethnologist for the Smithsonian Institution.) John said that on the Queen Charlotte Islands his dad lived with Henry Edenshaw and met Charles Edenshaw, master carver, whom he commissioned to carve totem poles and other artifacts for the American Museum of

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Richard Dattner FAIA, '60

Natural History. He said his dad brought back two black argillite poles and used to tell him what they represented. His recollection of those tales, alas, had failed, and John and Louise made the trip to see if they could get the stories the poles represented. Their report follows:

"Our tickets took us to two very large islands north of Vancouver, 60 miles off the British Columbia coast reached only by air or those huge 'Marine Highway' ferries. It is said that the Indians there, and everywhere, came across to the New World about 13,000 years ago, but the ones there are quite different from those elsewhere in the continent. Their number has been greatly reduced in recent centuries by white men's diseases, and the missionaries who tried to 'do away with all their heathenish doings.' Grampy blamed the missionaries for the social disruption he saw all around him. They had suppressed all the old dances and had been instrumental in having the old communal houses destroyed, the totem poles torn down. They had, he asserted, 'ruined everything that makes life worth living.' (Sept. 30, 1900).

"They knew our totems were old but could not tell us the stories pa had. Today there has been a rebirth and revival of Indian artifacts, and totems, not worn like ours, are worth over a thousand dollars. We did meet present-day carvers, but they could not tell us who carved ours. In one Indian artifacts store we asked a young lady how she knew so much about Dr. Swanton. She exclaimed, 'Why, we learn about him in school! He saved our language, he wrote our history, he made our culture known to the world.' As we were leaving the Indian museum in Skidegate, the phone rang, and the excited young lady who had been talking with us remarked, all excited, 'Who do you think was just here? JOHN SWANTON'S SON!!' It gave us an awesome feeling—this all happened 90 years ago!

"We traveled on through Prince Rupert, Wrangell, Juneau, and Sitka, learning all we could in their museums. The last few days we flew to Anchorage, with a fine museum and outstanding exhibits of Haida and Tlingit Indian life. Also in their wonderful gift shop we spotted a new book—*From the Land of the Totem Poles* by Dr. Aldona Jonaitis, published in 1988, for \$50. This we sent home! It is an outstanding book, beautifully printed, 270 shiny pages and many illustrations."

Quite some tale—there was a lot more but will have to save it for some other time. It was really nice that John and Louise could learn firsthand what his dad had done 90 years ago, and that he was still held in high esteem. It is things like this that often make life worth living—and hoping that what you do in life may be as favorably remembered by your grandchildren.—**Wyman P. Boynton**, secretary, 668 Middle St., Portsmouth, NJ 03801

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Our classmate **Albert Dietz** has had a full life as a professor at MIT's Department of Civil Engineering (1953-1962), then in the Department of Architecture (building engineering) (1962-1973), and then as professor emeritus and senior lecturer. He served on innumerable committees, national as well as at MIT. He's travelled throughout the world many times lecturing and has written countless articles.

On the occasion of Professor Dietz's 70th birthday in 1978, the Department of Architecture mounted an exhibition of his principal works. These included: his work on space heating in solar energy; his work as head of a plastic laboratory (a five-year project at MIT); his work with a highly-efficient split ring timber connector for engineered timbered structures; his work on laminated wood and "staggered truss" system of steel framing; his work on the "house of the future" where plastics would be used to the fullest extent because of its valuable quality; his work in conjunction with others on the Moscow Pavilions



Ruth and Albert Dietz

and the Greater London Council's 25-story flats (apartments), and the Stony Brook Village, a community of 250 small houses in Hyde Park, Boston; his work with the Mount Washington television station that had to withstand winds of 230 miles per hour; and his work in Florence, Italy, after the disastrous flood of 1966 (the rescue of priceless art objects). Professor Dietz also served on engineering education missions, which included Japan and Hawaii. Over the years, he has received many awards throughout the world. He has written about his experiences in foreign countries, and his style is excellent. He intertwines his work with his social contacts and observations. All this makes a fascinating travelogue. Perhaps at our 60th, we can prevail upon him to leave some copies in our memorabilia room. His wife, Ruth, has accompanied him as a helpmate and companion; they celebrated their 50th wedding anniversary in September 1986. They enjoy their two children and three grandchildren.

It is my sad duty to report the death of **John Bradley**. After his graduate work in architecture at MIT, he joined Bigelow & Woodsworth. In 1932, he began his own architecture firm, which later merged with Leland and Larsen. John designed the Washburn Hall at Episcopal Divinity School in Cambridge. He leaves his wife, Junia, two daughters, two sons, 12 grandchildren and one great-grandson. His grandson—John V. Goff, Box 8655, Salem, MA 01971—is in the process of writing a short biography of John to distribute to other members of the family. If any classmate has information about John's years at MIT, please send it to his grandson.

Class president **John Brown** reports that **Tom Weston** has graciously agreed to be chairman of the 60th reunion in June 1992. An organizational meeting was held in November 1990. The following decisions were made. Tom will form a full committee consisting of class officers and individuals who have been active in past reunions. It was agreed not to have an overnight stay away from Cambridge. A 60th reunion yearbook should be published, possibly including a brief paragraph about each classmate along with current addresses. All those paying class dues would receive a copy. To reduce the financial expense, many functions would be tied in with Technology Day and Cardinal and Gray activities. Special 60th reunion activities will be the class's responsibility. Information letters will be sent to all class members in the spring and fall of 1991.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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First the obits. **William A. Appledorn**, 10 Meadowcraft, Kalamazoo, MI 49002, died November 2, 1988. We have no other information. **Milton G. Davis** died September 5, 1990. His sister, Haline Hulbert, lives in Lincolnville, Maine. Davis won the Navy Cross in the Pacific Theater with the Marine Corp. . . . **G. Steinman**, address unknown, died November 9, 1990.

Niazi Mostafa died April 1, 1989, leaving a son, Hadem, MIT '63. After returning to Egypt, he set

up Nemus Engineering and represented, among other firms, GM, Cyanamid, and Crown Chemical. His latest project was toward the objective of a large demonstration for modern farm management. Haden has assumed management of the business. Mrs. Mostafa may be reached at the family address: 3 El Fardos St., Zamalek, Cairo, ARE, Egypt.

Bob White died November 30, 1990. He retired as director of the Torrington Co. and was general manager of its Needle Bearings Division before becoming vice-president. He was active in PTA, YMCA, Chamber of Commerce, Congregational Church, and Elks. Mrs. White is at 70 Four Story Ln., Torrington, CT 06790.

Walt Skees sends a very nice packet from Spain about the 500th anniversary of the discovery of America. . . . **Don Fink** collaborated through McGraw-Hill with Blair Benson, who had been editor of McGraw-Hill's television engineering handbook, on a new guide to HDTV. Just at the time of publication, Mr. Benson died. Apparently, this publication is an important adjunct to the burgeoning field of HDTV. . . . **Bill Houston** reports a very successful trip to Egypt last March (1990) through Alumni Flights Abroad. He came upon a relatively new discovery at the foot of Cheop's Pyramid; a ceremonial boat to bring his mummy from the funerary temple down the Nile to the pyramid for burial was recently found in a pit near the Pyramid, with instructions for reassembly! A mere 140 feet long! Cedar planks from Lebanon held together by ropes that tighten when wet. For you Floridians, the Houstons are at 1730 Lauren Ln., Orange Blossom Gardens, Lady Lake, FL 32159.

Jack Andrews and Jermain had a lovely trip to England last summer, including a rental car from London north to York and an 11-day walking tour of the Yorkshire dales and the Lake District. Jack was enrolled in an intergenerational program with the computer, which he indicates he has mastered insofar as word processing is concerned. . . . **Mel Ehrlich** has moved to California—100 Lockwood Ln., Apt. 108, Scotts Valley, CA 95066, (408) 438-8481.

Latest information indicates that the following ladies from our class are still with us: **Hazel Curtis**, Brandon, Vt.; Mrs. **Peter Geddes**, Providence, R.I.; **Madeleine Lynch**, and **Katherine I. McNeil**. If anyone knows anything about any of these ladies, please let your secretary know.

Norm Spofford reports: "Spent about 50 percent of the year in Taiwan teaching English and helping business people. Health is excellent. Exercise plenty. Have toured much of Mainland China and Indonesia."

Len Julian and **Doris** report big activity for the year. Their children and grandchildren apparently are extremely talented, 11-year-old Sam playing his violin in two symphonic groups and Rebecca at 8 playing her cello in a younger group (in Dallas and at the Cape during the summer). Daughter Sheryl at the *Boston Globe* is delivering all kinds of food stories. She was the recipient last spring of the prestigious Penny Missouri Journalism Award.

Ceil and **Harry Summer** are going to spend time right here at Hilton Head Island where Martha and I would be extremely pleased to see or hear from any of you via the phone book or personal visit.—**William B. Klee**, secretary, Box 7725, Hilton Head Island, SC 29938

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Please send news for this column to: **Robert Franklin**, secretary, P.O. Box 1147, Brewster, MA 02631; **George Bull**, assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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The last sentence of my class notes last issue was, "But I am glad to be back where the

weather is so predictable!" Predictable, bah humbug! It's Christmastime, and who in southern California would expect to have snow as low as 1,500 feet above sea level, daytime temperatures in the low 50s in North Inland San Diego County, and 38 degrees at Oceanside this morning? Not only that, but to have to put on chains to commute to work in San Diego, with only one lane open each way on I-8 East!

Natalie and Sam Brown report they are moving March 1 to 23053 Westchester Blvd., Apt. L-208, Port Charlotte, FL 33980. "As evidence of how rapidly time does pass, there are now four of our grandchildren in college with two more entering next September. The younger four are doing well in school and in various activities." Their new home is about two miles to both Kingsway C.C. and the Senior Citizens Center.

John Taplin, our new class president, plans to drive to Bernie Nelson's home to pick up a lot of papers and class notes that he has collected during his many years as our president. John also attended a seminar put on by the Alumni/ae Association, informing new class officers about procedures that MIT offers to assist them in their new assignments. In particular, the most effective ways to maintain close interaction with all our class members. John wrote, "The MIT instructors made it clear to us all that the most important class member is that individual responsible for (1) encouraging all classmates to write to their class secretary, and (2) for the class secretary to write up the class notes and forward to MIT for publication." I guess I am one of the lucky secretaries, for I have regular correspondents as well as some who suddenly realize they never have written and do so. Father time is cutting down on the number of "regulars," so I need more of you to "suddenly realize" and write.

We lost one of our regulars, a former class president, when Edward J. Collins died September 1 after a long illness. I had written to him prior to my trip east in October to set up a meeting, and I could not make connections. I finally received a letter in early November from Ned's older brother Tom, who lives in a nursing home in Randolph, Mass., telling of Ned's passing. Les Brooks, when he heard the news, wrote to tell me he had talked to Ned for over 20 minutes on August 11 and found him discouraged and not up to par. He had been in and out of hospitals for the past two years with a series of bronchial attacks. He spent a year at MIT's School of Architecture in graduate work and joined the War Production Board for the period of World War II. He was an executive and consulting engineer with Great Lakes Steel Corp., Detroit and Pittsburgh Mill Steel Co., New York City, before organizing Collins Construction Co., Hammond, Ind. in 1955, involving nursing homes, commercial, and industrial buildings. In 1958, E.J. Collins & Associates, Inc., was established in Chicago and did many projects in the nursing-home field. Ned retired to South Easton, Mass., in 1977, married Florence in 1983, and reported in the 50th reunion booklet that he was "trying to become a senior citizen and stay healthy." He played the full 25 years in our class golf tournaments. Florence died in December 1988, and he is survived by his first wife and three children.

I received word through the Alumni/ae Association that Lucius Packard's wife died at St. Simons Island, Ga., during the first part of 1990. Luke Packard had died December 5, 1976, in Melvin Village, N.H.

To end on an up note: Tomorrow my youngest daughter Melissa arrives for a day on her way to spend a week with her mother. I hope peace has been with us these last four months.—Allan Q. Mowatt, secretary, 715 N. Broadway #257, Escondido, CA 92025; (619) 432-6446.

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55th Reunion

As you read this column, our 55th reunion is about two months away. So I hasten to urge your

attendance and throw out some bait for consideration. I did not attend any reunion between the 10th and the 35th but then found that even one swap of recollections, or discussion of a mutual business or other interest, made it worthwhile and memorable.

So here is a sample of subjects that could produce good pow-wows and some classmates I know to have had an interest therein:

aeronautics—Bob Boden, Bob Lutz, George Trimble, Dick Murrow, Tung Lin, Bill Kennedy; building construction—Charlie Hobson, Bob Hunt, Mal Blanchard, Art Carota, Bill Mullen, Nelson Tower, Mike Tremaglio, Al Del Favero; chemical engineering—Bill Rousseau, Kelly Woods, Henry McGrath, Ed Nicholson, John Roberts; environment—Walt MacAdam, Doug Elkins, Bill Healy; finance—Bill Hastings, Phil Slater; geology—Doug Woodward, Bob King, Re Horner; quality control—Dorian Shainin, Dick Denton, Doug Hawks; sailing—Bob Gillette, Towers Doggett, George Webb, Pete Weinert, Ed Rowe, El Koontz, Willard Greenwood; unusual travel—Tony Hittl, Phil Gilinson, George Cummings, Roman Ulans, Clax Monro, Henry Lippitt, Dick DeWolfe.

The list is endless. Now, all you have to do is pick your own topic(s) and note the registration form appropriately. The committee will provide a bulletin board for matching interests. Hopefully, some future item in class notes will not cause reader reactions such as "I wish I had known that at reunion." In any case, use the up-to-date class directory, which you should have received, to contact your friends and get them to Cambridge in June for one more hurrah, especially at the class meeting on Thursday, June 6. Bob Gillette can arrange sailing on the Charles earlier that morning or the previous afternoon. And bring your 35MM slides of previous reunions for our enjoyment. A screen and projector will be available at Cape Cod and possibly in Cambridge.

A sad note from Jim Baker's wife, Ann, to Alice Kimball relates that Jim underwent carotid artery surgery and later suffered a series of strokes. Now he cannot communicate, although the cognitive area of his brain seems to be intact. He is obviously aware of what is going on and responds with facial expressions. He is back home with nurses around the clock and a doctor who makes house calls. Prior to his illness, Jim was making plans to attend the reunion. Anne says, "I know he will miss seeing his MIT friends. We have enjoyed reunions together in the past, and I do hope you have a great 55!" In the 50th pictures, Anne is twelfth and Jim ninth from left in the back row. Anne has arranged a speakerphone so Jim can hear both sides of a conversation, and I informed Harry Essley and George Trimble. Anne says that she welcomes calls from other old friends. Our hearts go out to Jim and Anne.

A letter from Charlie Saffer (Course V) tells of his experiences with Charles Lindbergh: "In 1945, I was with the Naval Technical Mission in Paris, to which Colonel Lindbergh was attached, and we had occasional contact. He was reserved but invariably pleasant and polite." On one occasion, Charlie introduced an industrial consultant to Lindy for a ride in his car to Versailles, but the consultant's unknowing reply was, "The face is familiar." Later he told Charlie: "I was halfway to Versailles before I realized I was sitting next to the most famous man in the world. I apologized to Lindbergh, who laughed!" . . . Charlie had another experience in the 1950s at the Army and Navy Club in Washington when (now) General Lindbergh was writing his book *Spirit of St. Louis*. To quote Charlie again: . . . extremely polite. A fine gentleman! For myself, I continue to work on my manners and mind. My class contacts now are with Louis Stahl and Bernard Vonnegut, close and cherished friends over the years."

Cheers for the lives of Jim Grove, Art Peel, and Everett "Hank" Cargen! Jim died in 1988 or earlier. He was Course IX and the 1961 *Alumni Register* lists him as president of Grove Laboratories, Inc. Perhaps some of his Chi Phi brothers

can provide more information. . . . Art Peel was Course II, and I knew him in Tech Show 1935. The November class column mentioned a trip to Greece with his wife, Virginia, to see their daughter, Barbara, and her husband who were on a worldwide bicycle tour. Today Barbara told me that her parents also traveled in the other direction to meet the tour ending in Hawaii. Art died July 28, 1990, after a series of strokes beginning in May, but he was in good health until then. He designed machinery for Scoville Manufacturing in Waterbury, Conn., until 1964, then continued with Revere Copper and Brass in Rome, N.Y., and into plastics rolling machinery. The dimes in our pockets owe their silver facings to his development of pressing machinery for the U.S. Mint. Virginia continues at 6432 Anderegg Dr., Rome, NY 13440.

Hank Cargen (Course IX), who was involved in all sorts of undergraduate activities, had a 50-year career of technical editing and writing—one of those rare birds who could put complex subjects into words that both professionals and laymen could understand and appreciate. In World War II, he was with Wright Aero, and later, in his own business, had Northrup, Lockheed, and Beckman Instruments as clients. Yet he brought humor into his explanations, so a layman would not throw up his hands at the first paragraph. One of his manuals for Lockheed became dubbed the rabbit manual—something concerning multiplying two into thousands, like rabbits. Hank was the picture of health until March 1988, when a touch of seeming arthritis turned out to be bone cancer, and by fall 1989 he was no longer ambulatory. He died January 29, 1990. All of this information came via a telephone call to his wife, Donna, herself a UCLA graduate, who illustrated Hank's writings. What a team! With so many classmates in and around aeronautics, I imagine some must have enjoyed their work. Donna continues the residence at 5058 Lakeview Ave., Yorba Linda, CA 92686.—Frank L. Phillips, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; James F. Patterson, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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Hurray for Christmas notes! We get more news this time of year than any other time. . . . Ruth and Phil Peters writes, "1990 has been good for us and our extended family. The big news is that, after 42 years, we sold our Wellesley home and purchased a cooperative apartment in Fox Hill Village, Westwood, Mass., a lovely 83-acre retirement community. Most of our 'nontraveling' time, however, will be spent at our favored Jackson, N.H., home. Reach us at 10 Longwood Dr., Suite 451, Westwood, MA 02090, and Juniper Hill—Tin Mine Rd., P.O. Box 272, Jackson, N.H."

Marge and Dick Young send their greetings to all and remind us that our reunion in Newport, R.I., is only 14 months away! Time slips by so fast. . . . John Fellouris, still in a glow after the fabulous surprise 75th birthday party his wife Peg arranged, writes, "Actually, however, according to the Greek calendar, I'm only 65!" (Ah, John—always the dreamer.)

Martha and Joe Smedile report that 1990 has been an interesting, exciting, but at times a frightening year for them. In May Joe fell into the intracoastal waterway near their home. He was manning the stern line of a neighbor's disabled boat as it was being pulled along the sea wall to his home. Joe stepped on a nearby dock that collapsed, dropping him and a neighbor's wife into the water. Joe had to tread water and support the woman while people went looking for a ladder to get them out. Joe ended up with several cuts, including one in the palm of his hand, apparently from a nail. Joe had his pipe in his mouth when he got dumped and he had it there when he was pulled out. That must have been quite a sight—somebody with a pipe in his mouth treading

water, with a woman hanging on to his back. A tetanus shot added insult to injury. In late June Joe and Martha boarded the paddle boat *Mississippi Queen* in New Orleans for a 12-day voyage up the Mississippi River. In October Martha fell in their home, hitting her head on the corner of a wall. The accident set Martha back so much that she had trouble walking with her cane. Fortunately, she has recovered to almost the point where she was before the fall.

Joe Heal writes, "For us 1990 was a difficult year. Marion had not improved, so in June we moved to a leased condominium in Mystic, Conn., to be close to our daughter, Joyce Payer. In September we sold our Florida home and purchased a condominium in Mystic. By November 1, Marion became completely dependent and even with two shifts of nurses to help out, we realized she would receive better care in the local Mary Elizabeth Nursing Center." Joe's address is Whitehall Pond #9, 207 Greenmanville Ave., Mystic, CT 06355.

Our sympathy goes to Joan and Bob Rudy who wrote, "1990 wasn't good for us. Our son Rick died in August after a long illness. It's been rough, but we are coming along OK."

It is with sadness I report the death of Charles Cheney Chase on September 6 in Tampa, Fla. He was a member of course XV and belonged to the Chi Phi Fraternity. Charles was a native of Cleveland, Ohio, and had been a management consultant most of his life and was formerly president of Systems and Procedures Association. He served as a Lt. colonel in World War II and was awarded the Bronze Star Medal and the Croix de Guerre. Following the war he served on the Hoover Commission on Task Force Management. Our condolences to his wife Dorothy, whose address is 2907 Euclid Ave., Tampa, FL 33629.—Robert H. Thorson, secretary, 66 Swan Rd., Winchester, MA 01890

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In addition to his golf, travel, and civic activities, Lou Bruneau has managed four years of summer courses and now is a Massachusetts accredited assessor.

About a year ago, Fred Kolb returned from an Elderhostel program in France. Now he is back from another 40 days in France including another three-week Elderhostel program at three different universities. He took advantage of the trip to spend leisurely time with longtime friends and associates from his many years of liaison with Kodak-Pathé. Previous to this, he took a guided tour into the Canadian Rockies and also visited friends in the Seattle area.

In another Elderhostel experience, a tutorial week on advanced German genealogy, Fred was able to identify his parents' forebears back five and six generations (to 1750-1730), thanks to the fabulous Mormon records in Salt Lake City.

In spite of all this travel, Fred is still active in several engineering committees, especially involving international standards. He has attended technical conferences in Orlando and New York, is consultant on a couple of patent cases, and his 240-word *Glossary for Electronic Production* is due for publication before these notes reach you.

We must report the sad news of the death of John Hains Landen on June 13, 1989. From my library of past alumni/ae registers, I know little except that he lived primarily in the Cincinnati area. A little research reveals that he served in World War II in the Marines from October 1941 to December 1945, attained the rank of captain, and was decorated with the Silver Star and the Purple Heart. Can anyone supply any additional information?

Do keep in mind the forthcoming mini-reunion at MIT's Endicott House Friday, June 7.—Don Severance, secretary, 39 Hampshire Rd., Wellesley Hills, MA 02181; Ed Hadley, assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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Bill Brewster and Lucile completed a 10-day safari to Kenya during summer 1990. Then they enjoyed cooler temperatures in Colorado at elevations where elk are to be seen. They fished for salmon near Murmansk before flying to San Diego where their son has the enviable assignment to captain the corps of lifeguards near Mission Bay Beach. . . . Win Reed and Margaret moved from St. Louis to Hendersonville, N.C., and have settled at 2,000-foot elevation between the Great Smokies and the Blue Ridge. They continue in good voice and find their new neighbors also welcome the fellowship of singalongs. . . . Ernie Kaswell and Yolande moved to Reston, Va., and continue their interest in textiles as they meet the challenges of rearranging what they sorted out from 24-years' accumulations in Massachusetts.

Martin Lindenberg and Mary are active in the MIT Educational Council; they interview executives for market research studies. Mary enjoys her art work and associated shows. . . . Ozzie Stewart and Lucille saw the Passion Play at Oberammergau and toured Austria, Hungary, and Yugoslavia. They expect to visit London, Paris, Stockholm, and Copenhagen during early 1991. Ozzie reports Charlie Wang and Julie have extended visas and reside now in El Monte, Calif. . . . Manning Morrill and Connie included travels during 1990 to Florida, the Carolinas, Alaska, and the Pacific Northwest. At home in Arlington at year's end, they resume curling sport and activities of the Garden Club.

We are saddened by news of the death on October 20, 1990, at Charlottesville, Va., of Robert Evan Pancake. There were no details.

Record wind velocities here toppled trees onto power lines as record rainfalls caused flooding and mudslides, and a cold snap froze underinsulated piping in homes that had no furnace power for five days. Hilda and I are grateful to neighbors for their help, as we struggled about 120 hours with one fireplace to keep the house and pipes warm. However, our user-unfriendly word processor refused to substitute kerosene for electricity to process these notes.—Hal Seykota, secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

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A letter from class president Norman Klivans comments on the good response to his letter of November 15 to all class members. There weren't many suggestions on the 1995 reunion, but the general reaction seemed to be in favor of spending a few days in Newport, R.I., before or after the reunion at MIT, so Norm is getting some material on hotels in that area. There was little response to the inquiry about a mini-reunion in 1992. If you have any thoughts about either of these events, send them to Norm at 3123 Bremer Rd., Cleveland, OH 44124, or to me.

Norm also had requests from 12 classmates for copies of the 50th reunion classbook. A number of them had notes, along with the checks. . . . Fredyum Henrikson expressed his regret at having missed a great affair. . . . Leonard W. Weaver remembered that the 1940 book had been an interesting one. As he is not a reunion attendee, he had no comments on future events. . . . In his note, Robert L. Hayes expressed his appreciation of all the work that the committee members had put into making the reunion such a success, even though he was unable to attend.

David B. Hoisington was sorry he couldn't make the 50th, but he had too many other activities at the same time. He celebrated his 50th wedding anniversary at his son's home in California in September, where his three children put on "quite a bash" for the occasion. . . . Bonner Hoffman sent his best regards. . . . Marshall P. Bearce had covered most of his news in response to the class questionnaire. Both he and his wife

have had health problems, but they are "survivors." He likes the idea of a mini-reunion in Florida in 1992. . . . In addition, requests for the book, without comments, came from John Gray, Richard Talpey, Herbert King, Lawrence Kelbley, David Heskett, and Robert Stocker. . . . There were a few remarks from Jack Lutz, who was at the reunion, but Norm did not forward those to me.

William Hagenbuch called me in mid November to report the death on November 13, 1990, of W. Kenneth Bodger in Laguna Hills, Calif. He had no further details.

Alvin Gutttag sent me a Christmas card that he sends to all course V members of the class of 1940. He included a note that this was the 51st time he has sent this course V card, and he still has copies of two-thirds of them. He almost decided to quit sending them after the 50th card, but changed his mind and will continue indefinitely.

Included in Norm's letter was a note and a document from Joseph Casey. He says, "It was a real joy to see you and the other fellow survivors at our 50th. You were having some difficulty not recognizing me as John (airlines) Casey. I'm the guy in the photo of class officers on page 46 of the reunion handbook." Joe further comments on a crusade he has been conducting for nearly two years, and the document he included was prepared for the Tampa Tribune, to be published in December 1990. It is entitled *The Nuclear-Element Project, A Profitable Plan for Survival*. This project, as proposed by Joe, would largely eliminate acid rain, urban smog, and the greenhouse effect. Modular nuclear mini-plants would be mass produced, and electric vehicles would be mandated to replace internal combustion vehicles over a period of 12 years. This would achieve independence from foreign oil by effectively eliminating fossil fuels. High production-line efficiency would be achieved, and design of the reactors would result in the safest category of certifiable safety. Fuel cladding would be optimized for disposal. A program for control of nuclear waste is included in the project, as is a complete economic analysis. It is an interesting paper, and I am sure Joe would be glad to send a copy to any class member who requests one. His address is 2523 Habana Place, Tampa, FL 33618.

David R. (Beano) Goodman sent me a page from *The Madison (Ind.) Courier* describing him as the 1990 champion Boys Club member for the state. Beano was presented the Indiana Area Council Board Member of the Year award, in Indianapolis, by Susan Bayh, wife of the governor. He won the award in competition with eight others throughout the state.

Send your letters and comments to—Richard E. Gladstone, secretary, 1208 Greendale Ave., Needham, MA 02192; (617) 449-2421

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50th Reunion

Eliza Dame of the MIT Alumni/ae Association called to advise me to remind you to make plans to attend our 50th reunion; which will, of course, be memorable. "Enough of your pessimistic and depressing death notices. Please print something cheery, something fun. Reunions bring laughter, thoughts of merry pranks, nostalgia." Of course she is right. But our classmates continue their dying ways. Perhaps it is just that time in our lives when the Great Mother calls us back.

His wife, Leona, informs us from Rolling Hill Estates, Calif., that James B. Cullison died in December 1989 at age 73. He transferred to MIT from the Armour Institute of Technology and studied mechanical engineering. He belonged to the Society of American Military Engineers.

A. Hoadley Mitchell writes from Edmonton, Alberta, Canada explaining that he does not plan to attend our reunion because his wife, Ruthie, has Lou Gehrig's disease and can no longer walk. They are spending some time in California where the mild climate is helpful. Hoadley is semi-

retired from the consulting group he started in 1949 but is still active in his family's oil and producing company. Hoadley was discharged, a major, in 1946. He has been a director of an airline, bank, uranium producer, mutual fund group, steel and pipe manufacturer, tool and equipment supplier, and several holding companies—quite a busy guy.

Malcolm J. Dodd reminded me that we sat together at our 40th reunion Pops concert, a joyous event. (Let's do it again.) He lives in a house he built near Tucson, Ariz. He sold the house in Litchfield, Conn., but leases an apartment so that he and his wife can spend July, August, Thanksgiving, and Christmas there. Their three children live around New England. Malcolm writes about an interesting experience he had last January as an expert witness for Northwest Airlines. (Before retirement, Malcolm's career was in the airline seat and related equipment field.) A passenger filed suit against them, claiming to have been injured because his seat reclined to the full horizontal position. The airline won the suit because Malcolm could prove it was impossible for the seat to perform as the plaintiff claimed. "I had to put on a classroom demonstration to convince the jury—blackboard drill, geometry lesson, etc." Malcolm plans to come to the reunion. I hope you all are.—**Joseph E. Dietzen**, secretary, Box 790, Cotuit, MA 02635

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Kudos to **Paul Hottel**, who was elected citizen-of-the-month by the Rotary Club of Stuart, Fla. He was also elected governor of the local Rotary district. If any of you are visiting the east coast of Florida, Mildred and Paul are living in St. Lucie.

Frank Staszsky sent a great picture of **Don Berky** playing a trombone at a Harwich, Mass., town band concert. Also, thanks to Frank, news from some of the survivors, (his word, not mine!) of the '42 Course IIA group. **Gordon Brown** is a realtor and gentleman farmer in New Hampshire. **Berky** and **Charlie Hofmann** live a few miles from one another on Cape Cod. Frank is cleaning up after Barbara's extensive gardening, entertaining their 11 grandchildren, and doing some management consulting in the energy industry.

Just received greetings to all from Rhoda and **Alan Katzenstein** in Larchmont, N.Y. He reports 40-degree weather there, which, of course, won't last much longer.

Betty and **Charlie Speas** attended the 100th anniversary of his fraternity, PBE, in Cambridge. Charlie gets around well in spite of contending with Parkinson's disease, and they plan to spend February and March in California.

Start planning to attend our 50th reunion just a year from this June. You'll be hearing more about this from George and from **Gerry Coe**, who will chair the festivities.—**Ken Rosett**, secretary, 191 Albemarle Rd., White Plains, NY 10605

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At the time of this writing, just before Christmas, few classmates seem concerned with sending in news, or passing on to their rewards so we can write an obituary.

In Cambridge, I see periodically class prexy **Jim McDonough** and **Chris Matthew**, El Supremo of the Alumni/ae Association. Their families are well, and the gentlemen are admirably discharging their official duties but submit no detailed reports. . . . **Betty** and **Bud Cruckshank** continue to enjoy the RV life down South but have an occasional foray back to Connecticut to remind themselves of what winter is like.

Marion and **Gil Monet**, in romantically-named Willow Street, Pa., report the marriage of astronomer son David to a lady astronomer. The happy couple both work for the U.S. Naval Observatory in Flagstaff, Ariz. Gil is immersed in sculpture, taking lessons and winning prizes with

bas-relief portraits. In a recent course, he made two interesting and unusual objects. One was a bas-relief of the mythical Navajo thunderbird with a painted plaster surface, covered with polystyrene foam and mounted on a gold mat. The other piece was a mobile consisting of a beam with a reddish-orange cube on one end and a yellow sail shaped like the tail of a whale on the other.

Besides sculpture, Gil is still teaching recorder and taking weekly piano lessons. Marion's activities include playing cello with various community orchestras while still taking weekly lessons in that instrument. So, classmates, you can see there is more to retired life than playing golf.

There has been some shuffling of the site for our 50th reunion. I'll report further when I have more information.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

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John Bovicchi, a 26-year member and professor on the faculty of Berklee College of Music has been awarded the prestigious American Society of Composers, Authors and Publishers (ASCAP) Special Award for Excellence in Composition. The 1990-91 award is Bovicchi's 26th in the 30-year history of the Special Awards Program. Selections from Bovicchi's original catalog, which lists over 100 compositions and is published by Oxford University Press, among others, have been performed all over the world including Australia, Peru, and at the Cardiff Festival in Wales. Bovicchi is noted for his tenure as musical director of the Arlington Philharmonic Orchestra and chorus. Last spring he directed the orchestra's performance of Dvorak's *Te Deum* and Mozart's *Missa Brevis* at their annual winter concert.

Kenneth Scheid sends along some thoughts about MIT's future educational and research missions. He states the time has come to re-cast MIT as the "Massachusetts Technological University" with two main divisions—MIT (Engineering and Architecture) and College of Science and Arts. In Europe, he believes the term "Technological University" is elastic enough to cover a rather full range of disciplines and professions. He questions how long MIT can maintain its traditional nature.

Peter Matthews reports that his daughter, Andrea, is in Aachen, Germany, until July 1992 with the Stadttheater of Aachen. If any of us find ourselves in Aachen before July 1992, Peter directs us to go to the opera and hear her sing as Pamina in *The Magic Flute*, as Despina in *Così fan Tutte*, and as Susanna in *The Marriage of Figaro*.—Co-secretaries: **Andrew Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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Please send news for this column to: **Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

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45th Reunion

A November note from **Larry Body** included a nice photo of himself, Ginnie, and Fran and **Jim Corbett**—one of our many suite mates in the Grad House—basking on Jim's patio in Southbury, Conn., before returning to their Santa Ana, Calif., home from a vacation in New England.

Several of you may have received a copy of **Bill Cahill's** blockbuster newsletter about his and Shirley's children, grandchildren, nieces, and nephews. He also relates some adventures coming home from golfing on Maui and the Big Island. The letter was accompanied by a picture of their elegant Glen Brook home overlooking Lake Tahoe.

Mario Vinci writes about a trip to the Bahamas with his wife, Rose, and his daughter's wedding.

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... From Hastings-on-Hudson, we hear from Penny and Stan Young that Stan has retired after completing a project for NYNEX, while Penny is still with a law firm, hoping to bow out sooner than later. . . . A picture postcard from Norm Sas, whom I haven't seen since our trip around the country in the summer of 1947, shows the Sases on swings, rings, and bars with their four children—two boys, two girls—and two grandkids. Norm and his wife live in Alpine, N.J., and have built a winter house on an island off Vero Beach. He has recently sold Tudor Games Inc., the company he worked for and has been president of almost ever since our 13,000-mile trip in Norm's car. The trip, incidentally, included Jim Chabot, who I just found out has moved from his Michigan home to a town in the southern part of Virginia's blue Ridge. If you'd like more information, give me a buzz at (303) 757-5261. —Jim Ray, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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This month we hit the jackpot—three long letters!

First, Al Richardson reports that after playing golf for 52 years, he scored his first hole-in-one! The momentous event happened September 14, 1990, on the sixth hole at the Winchester Country Club. And, later in the same round, he came within 8 inches of a second hole-in-one! Al also reports he got a new Department of Energy grant for his business—the third from DOE. He's also been successful in getting IEEE to withdraw a proposed vibration standard. From a personal point of view, Al and Phyllis are planning a "vacation of the month" this winter—a different sun spot each month: Bermuda, Grand Cayman Island, Marco Island, Palm Springs. Sounds like a dedicated golfer's winter dream. Phyllis just celebrated her 65th birthday and Al gave her a new Cadillac. (At that rate, she may want to repeat the 65th each year!) Al says he probably should think about retirement but isn't sure what he'd do because he plays golf four times a week now!

Jim Prigoff writes from Sacramento. He and Arline have lived there for a year, although he goes back and forth to San Francisco quite often—and they still have a condo there. Arline is an assistant professor in the California State University at Sacramento's Department of Social Work. She's been doing a lot of social work, which included a trip to El Salvador, Costa Rica, and Lima, Peru, this past summer. She and Jim spent a few weeks camping on the Atlantic and Pacific coasts in Costa Rica, and drove some 2,000 miles in that tiny country. Jim says that compared to the hardship of people's lives in the rest of Central America, Costa Rica seems better able to cope with human needs. Last May, Jim visited Vietnam with a friendship committee and was also able to get into Cambodia for a brief but exhilarating visit to Angkor Wat. (While he was there, the Khmer Rouge took a town just nine miles away!) He took extensive slides and has been lecturing on his impressions. Otherwise, he's still keeping up his squash activity—he and his partner were runners-up in their age group in the 1990 Canadian National Doubles. Jim is continuing his documentation and lecturing on public murals and spray-can art, and his book has sold some 70,000 copies worldwide in two and a half years—quite extraordinary for an art book. Family report—Jim and Arline have 11 grandchildren, from 5 months to 19 years!

Arnold Judson reports that his new book, *Making Strategy Happen*, has just been published by Basil Blackwell, Inc.—and he will have a second book, *Changing Behavior in Organizations*, published next spring. Both books address the issue of strategy implementation and are the first to do so in any depth. They are the distillation of what Arnold's firm (Gray-Judson-Howard) has been doing for the past 30 years. The firm focuses on helping senior executives institute strategic

management as the process for conducting their business. Their clients are primarily in North America, but also include some major corporations in Europe and Latin America. On the personal side, Arnold and his wife, June, just celebrated their 42nd anniversary. They live in Boston's Back Bay (staying close to MIT, Arnold?) and have two married daughters and two grandchildren living nearby. June is active in the theater—she produces and directs staged readings and occasionally, full productions of new works. Arnold reports that he plays squash every morning for exercise and also tries to keep up with his piano. He has also been active with MIT in the last 10 years—serving on the Department of Humanities and Social Sciences Visiting Committee and the Alumni Council.

We'll report some personal news from the McBrides this month, too. We spent most of November wandering around the south island of New Zealand. That is a beautiful country—and beautiful people. They are so hospitable, it's unbelievable. We spent several nights with New Zealanders in their homes and/or farms. Scenic highlights: almost too numerous to mention. Milford Sound, Queenstown, glaciers, West Coast, delightful small towns, etc. etc. If any of you have a chance, go!—Robert E. McBride, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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In January, Harold Ottobri, George Clifford, Bob Sandman, Malcolm Reed, Don Noble, Milton Slade and yours truly met at Harold's home to discuss reunion plans for our class. I had sent a letter to class officers (current and past) requesting comments about our plans. Bill Weisz, Ken Brock, Warren King, Jack Page, and Bill Zimmerman responded with their comments. Harold Ottobri is chairman of the 1991 reunion, which we have planned with the classes of '47 and '49. By now, you should have received a letter with complete reunion information and registration materials. It is scheduled for the weekend of September 27-28, 1991, at the Harbor View Hotel in Edgartown on the island of Martha's Vineyard.

Professor Robert M. Solow of the MIT Economics Department will join us on Saturday morning for either a talk or a seminar. Bob received the Nobel Prize in Economics in 1988. He has spoken at the MIT Club of Providence twice in recent years, and both times questions continued for over an hour after he finished speaking. He is one of three authors of *Made in America—Regaining the Productive Edge*. The book was the result of the MIT Commission on Industrial Productivity and describes strategies for industry, labor, government, and education that will lead to a substantial improvement in American industrial performance. The book concludes that without major changes in the ways Americans learn, produce, work with one another, compete internationally, and provide for the future, no amount of macroeconomic fine-tuning will be able to produce a rising standard of living in the long run.

Martha's Vineyard offers a variety of activities for our enjoyment—golf, tennis, sailing, shopping, museums, nature walks, scenic tours. Eleanor and Harold Ottobri, who arranged a gala event at Rosediff in Newport in 1985 and our dinner-dance at Walker Memorial during our 45th Reunion in 1988, will arrange another dinner and dance on Saturday night, September 28. Dress will be sport coat and tie for men and cocktail dress for women.

Peter Saint Germain was awarded the Dalton Bowl by the Corporation Development Committee (CDC) for his exceptional contributions to the committee and for his fund raising efforts for the Institute. The award was reported in the February/March issue of *Technology Review* on page MIT 5. . . . Don Atwood has been deputy Secretary of

Defense since the beginning of the Bush Administration. Before that, he was vice-chairman of GM. Don's aim of boosting the Defense Department's efficiency was described in an article by David Smith in Ward's *Auto World*. Don says, "While the defense department has been studied to death by all sorts of special commissions, their recommendations were never very well implemented." Don's approach has been to conduct the study with the same people who have to implement the recommendations. One practice he is transferring to his government job from his experience at GM "is the technique of participative management." Over a number of years the Pentagon bureaucracy has grown, and what they are trying to do is eliminate layers of management, layers of bureaucracy and a tremendous amount of non-value-added work. There are major differences in the way Defense and big private outfits like GM operate, according to Don. If GM suppliers don't measure up, they get sacked. At Defense, practically anyone can make a bid, "and every supplier has at least two senators and one representative who make sure they are at least reviewed." Eliminating redundancies and consolidating operations are among his chief goals. The Pentagon had 27 payroll systems, and there's no reason to have more than one. Each service had its own financial department, when Don arrived, although only one is necessary.

Another inefficiency at Defense is the existence of numerous unnecessary standards. Commercial specs can suffice more often than not. Don agrees that Defense cannot buy commercial "machine guns or tanks," but wryly adds that "there are hammers, there are coffee pots" it can purchase at True Value prices.

An article in Delco Electronics' employee newspaper describes Don as "an extraordinary individual—a combination of scientific knowledge and insight, business acumen, and a strong entrepreneurial inclination." Don is an extremely private man who modestly downplays his contributions. He joined GM in 1959 when they bought a company that Clark Draper, Don, and two others had founded.

Ezra Garforth, Jr. is enjoying retirement. He is active with SCORE (Service Corps of Retired Executives) and is counseling about 15 small businesses. He is vice-president of Country Club of Charleston, which was totally destroyed by Hurricane Hugo, and serves as chairman of new construction. . . . John Kaymen's daughter, Harriet, died last year from an illness contracted in service with the Peace Corps in Africa. Another daughter, Amelia, has begun her practice as a dermatologist in San Francisco. His son, Stanley, is a merger-acquisition specialist for Societe Generale, a large bank in Paris, France. . . . First, John Farrow retired from corporate life and now he has retired again, this time from the resort motel business. He keeps active in local government, having served as police commissioner, mayor, and now chairman of the Board of Adjustment.

In December, our class had a champagne brunch at the MIT Endicott House. We gathered in the Gun Room surrounded by assorted rifles and hunting trophies. After brunch we reviewed plans for the reunion on Martha's Vineyard. The following classmates were there: Jean and Milton Slade, Agnes and George Fountas, Betsy and Bill Maley, Judy and Graham Sterling, Barbara and Malcolm Reed, Gloria and Sonny Monosson, Stanley Shein and Irene Kalfon, Dorothy Seltzer, Al Levenson, Eleanor and Harold Ottobri, Joan and Sam Hanna, Tel and Bob Sandman, Ginny and George Clifford, Anita and Verity Smith, and Marty Billett.

Joining us at the brunch were the following members of the class of 1949: Robert and Mary Cowan, Harry and Jean Lambe, Demetri and Pandora Ligor, Jim and Dot Christopher, and Fletcher and Nell Eaton.

Elias Corey was awarded the 1990 Nobel Prize in Chemistry for inventing new rules that allow chemists to make complex new molecules from

ordinary chemicals. The complex molecules range from new drugs to paints and pesticides. Before Elias' work, organic chemists worked out the synthesis of each compound separately, largely by trial and error. Now they can use general rules developed by Elias to put together compounds. His friends call him, E.J., and he has been on the Harvard faculty since 1959, where he still teaches first-year students.

Edward J. Ewing was living in Clayton, N.J., until his death in October 1990. . . . **William F. Halbleib** was living in Rochester, N.Y., before his death in September 1990. . . . **Robert B. Cook** was living in Sonoma, Calif., before his death in August 1990. Bob served in the Navy during World War II. His son, Kenneth, wrote with information about Bob's four children. Bob and his sister visited Papua-New Guinea last spring. . . . **Don Marshall** was living in La Jolla, Calif., before his death in April 1990. He is survived by his wife, Jeanne, and his daughter, Susan M. Rush.

On behalf of our class, I extend our sympathy to the families of these four classmates.—**Marty Billett**, secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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Incident at Prout's Neck, Maine. Although the fog was thick enough to slice, wrap, and ship down to the eager market in Boston, **Gene Wroblewski's** spirits were high as he took in the gloomy view outside the window where he was finishing breakfast at the Blackpoint Inn. He and others from the class were putting the finishing touches on our 40th reunion. Shortly they would go their many ways.

Rising from the table, Gene went outside to grope his way through the mist to his car. Here his spirits took a sudden plunge because the car wouldn't start. Harsh language, the only remedy he knew, did no good and, fearing he might burn out the starter, he called his AAA Road Service Club for assistance. Returning to the car, he threw open the hood and looked in. Meanwhile, some of the finest minds in the technical world got up from their rocking chairs on the porch and came over to give advice. Gene gratefully accepted all suggestions—but nothing worked. Presently, the tow truck arrived, driven by a mechanic wearing greasy overalls and carrying a toolbox. In less than 60 seconds, he had the motor started.

There must be a lesson hidden in here some place and it is this. Looking back, Gene is glad the mechanic didn't know about the towering intellects gathered to watch him, for, if he had, Gene feels sure, he would have retired from the scene, leaving the problem to the experts.

John Alger writes from Rumney, N.H., that "living in the country on a dirt road is exciting! I am town moderator, a SCORE (Service Corps of Retired Executives) counselor, on the Conservation Commission, the planning board, plus other 'work.' my wife is state woman's representative for SCORE and active in our River Association. Our two grandchildren are great as are our own kids. Call and visit, but bring your work clothes!"

Blair Manning enjoyed two trips this past year: (1) Rafting down the Grand Canyon with alumni from Duke University (his wife's graduate school), and (2) traversing the Inside Passage to Alaska aboard the S.S. *Rotterdam*. In February 1991 (if plans didn't change), he visited the rain forests of Costa Rica with an elderhostel.

Jack Fogarty, once again, sent me his Christmas letter filled with interesting facts and comment, this time about the Middle East, where, at some risk, he and his wife spent three weeks on an elderhostel. They spent one week each in Athens, Istanbul, and Jerusalem where, three weeks later, the shooting at the Wailing Wall occurred. Did they see any signs of hostilities? Well, yes.

"Perhaps the most telling signs were splashes of black paint on many walls, doors, and fences

in Bethlehem and Jerusalem. Who were the vandals who had done this? The army. They paint over the Intifada slogans and nobody bothers to repaint because it would only invite the sloganeers, and the army, back again." I am tempted to quote Jack's entire letter but space forbids.

Those attending our class reunions always come away saying they had a great time. But with time passing more rapidly for most of us these days, there are some who feel once every five years is not often enough to see our friends from school. And that includes students in classes other than our own. So, why not get together more often? That is precisely the idea which has motivated Marty Billett, president and secretary of the class of 1948, to arrange a mini-reunion of the classes of 1947, 1948, and 1949 on Martha's Vineyard in the fall (September 27 and 28).

Last night (Wednesday, January 2, 1991), **Tom Toohy**, Jean and **Harry Lambe**, Pam and **Mickey Ligor**, Dot and **Jim Christopher**, and Nell and myself met at the Faculty Club to start the planning that always goes into a reunion. We agreed to send each of you a letter describing the event and inviting you to come. For auld lang syne, we hope to see you.

I might add that the class of 1948 has already done most of the work. A large block of rooms at the elegant Harborview Hotel has been reserved and a social agenda has been arranged.

James M. Langley, Jr., 63, of Concord, N.H., died September 26, 1990, after a sudden illness. According to the September 29, 1990, issue of the *Manchester Union Leader*, Jim was born in Concord and spent most of his life there. At Tech, he majored in aeronautical engineering and went on to work in the wind-tunnel research program for several years. Following this, he worked for more than 20 years as a computer specialist in the New Hampshire Department of Transportation. Survivors include two sons, James M. Langley III of Santa Cruz, Calif., and Matthew C. Langley of North Berwick, Maine; a daughter, Beth Houle of Springvale, Maine; six grandchildren; a sister, Joyce Meyer of Tacoma, Wash.; and nieces and nephews.

Paul S. Bercow, 63, of Scotch Plains, N.J., died October 29, 1990, of colon cancer. According to the *New York Times* issue of November 1, 1990, Paul was vice-president of Robeco Chemical in Manhattan, founded by his father in 1918. Paul was born in Brooklyn, majored in chemical engineering at Tech, and served in the Navy during World War II. He was a director of the Y.M./Y.W.H.A. of Union County. He is survived by his wife, the former Greta Epstein; three sons, Jeffrey of Miami Beach, Gary of Spencer, N.Y., and Dr. Neil of Brooklyn; a brother, Alan of Englewood Cliffs, N.J.; and five grandchildren.

The class extends its most sincere condolences to the families of these two men.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192; (617) 449-1614

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Please send news for this column to: **John T. McKenna**, secretary, 182 Midpine Rd., Cummaquid, MA 02637

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40th Reunion

It is almost time to start packing our luggage and heading for that major event that we have been anticipating for so long, our 40th reunion. The response to our class questionnaire and the early enrollments indicate that this will be a record shattering turnout. Be certain that you aren't the only one who is missing.

We hope that you have by now taken advantage of the wonderful opportunity afforded to us by the Grace B. Kerr Challenge Fund enabled by the generosity of **Breene Kerr**. This \$400,000 challenge will provide the boost needed to insure that our

Class of 1951 Fund for Excellence in Education gets off to the start that it so well deserves. The challenge, the need, and the opportunity is there. It is now up to you and all of us to make the most of it.

The American Society for Engineering Education has awarded this year's Faculty Professional Development Program Award to Professor **Peter J. Philiou**. The award was given for Peter's study of "laser and optics for applications." Peter, in his spare time, cochaired the handling of our class book for our 40th reunion.

The distinguished Henry Marion Howe Medal is awarded to the authors of the best article published in *Metalurgical Transactions*. One of the recipients of the award this year is Professor **Merton C. Flemings**. It was recognizing his work in coauthoring the article "Infiltration of Fibrous Preforms by a Pure Metal: Part I Theory." Professor Flemings is the Toyota Professor of Materials Processing at MIT and is considered a leading authority on solidification and crystal growing.

The man known as Mr. COGO, Professor C.L. Miller has recently published a new book, *The COGO (COordinate GeOmetry) Book—Fundamentals, Conventions, and Standards of Coordinate Geometry for Civil Engineers and Surveyors*, his favorite subject. The book covers the full scope from basics to database construction needed to make full use of what has become a keystone tool for civil engineers. It also provides an exposure to the historical background of this widely-used computer tool.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

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Art Turner writes that he is now directing atomic spectroscopy product development at Baird Corp., now a division of IMO Industries. One son is a junior in high school and the other is in graduate school at RPI studying physics. Sally, his wife, works for MIT Lincoln Labs. As one of our reunion committee members, Art is actively organizing our 40th reunion.

Last fall, the Christian Science Church of Marblehead sponsored a lecture by **Robert W. Jeffery** of Franklin, Mich., entitled "Why Would Anyone Choose Prayer Instead of Medicine?"

Unhappily, neither prayer nor medicine sufficed for **John B. Savoca**, who died last September 25, 1990. He was a district manager for contractor sales for the Trane Co. and had served as chairman of the Framingham Industrial Development Authority and as a corporator for the Framingham Union Hospital. He is survived by his wife Joyce, three daughters, a son, and seven grandchildren.—**Richard E. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

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I have quite a few items this month so I'll get right to it, the short ones first.

Karl Epple retired in September 1990 as president of the Emhart Corp. Heli-Coil Division in Danbury, Conn. . . . **Wolf Haberman** reports that he is still at MITRE Corp. in Bedford, Mass. He is still busy in Framingham, Mass., town government after 18 years. He has three grandchildren, and the last of four children will be married in March 1991.

Macmillan Publishing Co. published **Mort Grosser's** *The Fabulous Fifty*, which I reported in preparation in an earlier column.

Virginia and **Wally Reid** are still holding forth in Kennebunk, Maine, according to the *York County Coast Star*. They have been in the innkeeping or bread and breakfast business since the time of his education at MIT. They have brought up six kids. They occasionally traveled to Wally's Air Force Reserve tour bases for limited periods, but they always returned to Kennebunk where they are truly long-term residents.

Dick Linde wrote me a long letter that

reminisced about the last reunion. At the writing of this column, we are halfway to the next. Dick took early retirement in February 1989. He has continued in consulting work until recently, and has now entered the field of tax-return preparation. In August 1990, he and Ruth returned to apartment living after 28 years in detached houses. His apartment overlooks the Hudson River and they enjoy the ever-changing view. His older son Mark had been in real-estate management and brokerage but has recently shifted to restaurant management. His youngest son Peter graduated from Columbia University of Engineering in June 1989 and joined Ford Motor Corp. in Dearborn, Mich.



Fred Brecher

Fred Brecher formed a new, independent consulting engineering firm in Philadelphia, Pa., on October 1, 1990. He specializes in the design of building structures and has additional expertise in forensic engineering. Fred holds professional licensing in Pennsylvania, New Jersey, Delaware, Maryland, North Carolina, Florida, and Kentucky. The list of significant projects attributable to Fred is too long to include in this column.

The *Monadnock Ledger* of Petersborough, N.H., recently published an article about Miriam and Rick Lockhart and their experiences in Saudi Arabia from 1979 to 1985. Rick and Miriam have three children and have had a series of interesting experiences in the time since Rick graduated from Tech. Rick answered an ad to oversee construction projects in Saudi Arabia and spent the next six years there. The article discusses, in detail, the significant cultural differences between our societies, which you have all read about recently, so I won't repeat them. Rick returned to the United States in 1985 and settled in Cambridge, Mass. The lure of organic gardening drew them to New Hampshire, where they bought a 1785 yellow clapboard house that they are currently expanding by a factor of two. They continue to follow closely the events in Saudi Arabia, but I suspect they are glad to be back in the old USA at this time of uncertainty.



Allan Hoffman

I've also heard from Allan Hoffman, professor of chemical engineering and bioengineering at the University of Washington, Seattle. Allan has an active research group in the area of surface modification of polymers to enhance bioactivity or biocompatibility and special focus on water-soluble polymers and hydrogels for drug delivery, diagnostics, and separation. At the July 1990 meeting of the Controlled Release Society in

Reno, Nev., Allan received an award for "Excellence in Guiding Graduate Student Research." He will also receive the 1990 Award for "Distinguished Service in the Advancement of Biomaterials Science" from the Japanese Biomaterials Society, the first time awarded to a foreign scientist. He has more than 170 publications to his credit, as well as 12 patents and several patents pending. Allan, I hope you can join us at the next reunion. Got to get in the commercials.

Inc. magazine of Boston reports that "The Wizard is Back!" "Henry Kloss, the most famous name in the history of audio technology, is back on top with a new line of speakers." According to the article, Henry created the first high-quality cassette deck, the first high-quality table radio, the first portable hi-fi system, the best-selling speakers of the 1960s, the first relatively inexpensive projection television set, and the best-selling speakers of the 1970s.

Henry established acoustic research in 1953 and the AR-1 was born. In 1956, he and his associates, Low and Hoffman, formed KLH. Henry developed the Model 6 speakers, the Model 8 FM radio, and the Model 11 portable stereo. He moved to Advent and soon, working with Dolby, released the first commercial Dolby tape recorder. Later he combined it with high-quality chromium dioxide tape. The Advent became the standard when it hit the market in 1970. He is currently involved with "Cambridge Sound Works, Inc." One of his projects is designing three new speakers for KLH.

And finally, it saddens me to report that Joseph E. Malloy died on September 5, 1990, in Lexington, Mass. He is survived by his two sons, Daniel and David, both of Lexington.

In closing, let me again request that classmates in the New England area volunteer to serve on the next reunion committee. Since many of us will be retired or approaching retirement, the reunion should be a good opportunity to get away and see some of the old gang again. I would appreciate a letter from any and all telling about your activities. I may not print it all, but I'll try to include the interesting parts for all our classmates to enjoy. Until next time, so long.—Gilberg (Gil) Gardner, secretary, 1200 Trinity Dr., Alexandria, VA 22314; (703) 461-0331

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A letter from Klaus Zwilsky informs us that he received the National Materials Advancement Award of the Federation of Materials Societies in December. The award recognizes individuals "who have demonstrated outstanding capabilities in advancing the effective and economic use of materials in the multidisciplinary field of materials science and engineering generally and who contribute significantly to the application of the materials profession to national problems and policy." Klaus is the executive director of the National Materials Advisory Board in Washington, D.C. He has published some 30 papers related to high-temperature and nuclear materials, materials policy, and critical and strategic materials.

Phil Sayre has been named president of Butler Automatic, Inc., in Canton, Mass. He was formerly chairman of Management Consultants in Guilford, Conn. . . . Renaldo Rivero has been elected president of the MIT Club of Southern California. . . . I hope to report the news from those who are sending holiday greetings next issue.—Edwin G. Eigel, Jr., secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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We received a doubly welcome letter from Rod Joblove containing news of his recent exploits and a check to be forwarded to the Alumni Fund whose mailing address he had lost. Rod spent about six months last summer traveling through

the Yukon, Northwest Territories, and Alaska. He kayaked several rivers and spoke lovingly of the pleasures of being upside down in frigid waters. He also backpacked, biked, and drove all the way up to Prudhoe Bay—even sat out an earthquake somewhere in Alaska! Rod's next adventure will be working as a volunteer for four or five months at Dinosaur National Monument as a paleontological assistant (a fancy phrase, he suspects, for a "gopher"). He seems to be enjoying life immensely and vows to be at the next class reunion.



M. Hablanian

Marsbed Hablanian has been named a Varian Fellow by Varian Associates Inc., in honor of his numerous contributions to vacuum engineering and technology. Marsbed is manager of advanced research and development at Varian's Vacuum Products Operation in Palo Alto, Calif. He holds eight patents and has published more than 80 technical papers and a new book *High Vacuum Technology*, by Marcel Dekker, along with numerous chapters, monographs, and entries in technical encyclopedias.

Zaven Dadekian is in the news as project chairman of the Armenian General Benevolent Union for the development of a modern plastic surgery center at Erebouni Hospital in Yerevan, Armenia. The project involves the construction and equipping of a 25,000-square-foot facility and the training of a 15-member medical team at the Yale University School of Medicine and Yale-New Haven Hospital. The medical education and facility development project is in response to the devastating 1988 earthquake in Armenia.

A chance meeting by one of your co-secretaries with James "Abe" Abrahamson gave us an opportunity to get up-to-date on this illustrious classmate. Jim has now retired as a lieutenant general from the Air Force, after leading the Strategic Defense Initiative program for five years, and is now executive vice-president for corporate development at Hughes Aircraft Co. He looks to be in terrific shape and doesn't appear to have aged a day since 1955!

Keep those cards and letters (with or without Alumni/ae Fund checks) coming.—Co-secretaries: Roy M. Salzman, 481 Curve St., Carlisle, MA 01741; James H. Eacker, 3619 Folly Quarter Rd., Ellicott City, MD 21043

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35th Reunion

We are going to have the best "35th" we have ever had. The reunion committee continues to meet and refine plans. You should be getting direct mailings and I trust you are making plans to attend.

William Dickson has a new affiliation as chairman of the board, Harvard Coop Society as reported by the *New York Times*. Bill remains senior vice-president of MIT. . . . Joseph Goodwill (Pittsburgh, Pa.) got a chance to write us over Thanksgiving. He is still at Carnegie Mellon University. Joe is the director of EPRI Center for Materials Production, and he organized an international conference in San Francisco on thermal plasmas and works to improve U.S. manufacturing with electro-technologies. . . . We hear that James Hamblet went to Korea compliments of ROTC—almost as good as duty in beautiful

downtown Lawrence, Mass. And he didn't even have a housegirl.

Bruce Montgomery, associate director of the Plasma Fusion Center at MIT has received the DOE Distinguished Associate Award (only the second time that this award has been presented) for "recognition of outstanding contributions to the developments of magnets for fusion research and for a leading role in engineering development, design, and fabrication of the Alcator high field tokamak experiments and the design of the Compact Ignition Tokamak. . . . **Judith Ronat** (nee Gorenstein) graduated with **Elhanan Ronat** (deceased as noted in August/September issue), and they were married on graduation day in the then new chapel, an event which we overlooked. Many thanks to Judy for getting back to us.

We were informed by Lauren Steigerwald Bobbitt, 5613 Mantachie Ct., Raleigh, NC 27610, that **Bernard J. Steigerwald** died on November 5, 1989. . . . Florence B. Tenzer, 55 Henry St., Brooklyn, NY 11201, reported that **Benjamin Tenzer** passed away on May 2, 1990, from ALS (Lou Gehrig's disease) after six years of suffering. Our thoughts are with our departed alumni and their families.—Co-secretaries: **George H. Brattin**, 39 Bartlett St., Andover, MA 01810; (508) 470-2730; **Irwin Gross**, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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Please send news for this column to: **John Christian**, secretary, 23 Fredana Rd., Waban, MA 02168

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Writing the April column in December is always a delight because visions of spring, rather than sugarplums, dance in my head. Having survived another snowy Christmas, I keep wondering how such warm weather, beach people like Nancy and me keep ending up in the frost belt.

At any rate, Santa's mailbag brought a cheery note from **Al Weiss** telling us about his latest adventure. Al writes, "Just to recap old news, back in 1973 I left my job with IBM, purchased an abandoned gold mine in the California Sierras and opened a summer resort. That lasted until 1980, when I sold the resort and returned to computer programming as an independent consultant. Well, I'm at it again. I have just been accepted as a United Nations Volunteer and am about to leave for a two-year assignment in Bangkok, Thailand. I will be working with ESCAP (Economic and Social Commission for Asia and the Pacific) in developing a computer system to gather and analyze information for the promotion of joint ventures among ESCAP members. The ESCAP region stretches from Afghanistan to Korea and New Zealand. I guess some people just have a short attention span. My address over there will be: c/o U.N. Development Program, G.P.O. Box 618, Bangkok 10501, Thailand."

Liz Drake is now associate director for New Energy Technology with the MIT Energy Laboratory. Recently, she received the 1990 T.J. Hamilton Memorial Award from the American Institute of Chemical Engineers. This award commended her involvement in the government program's steering committee and in two sponsored research programs for chemical process safety for waste reduction technologies.

Down at Myrtle Beach, S.C., the AVX Corp. announced that **Ben Rosen** has been named president. Previously, Ben was executive vice-president of this major manufacturer of electronic components.

During my travels, I ran across a "Barone" Chrysler automobile dealership in the Philadelphia area, took a photo of it, and sent it along to **Dick Barone**. Dick sent a letter back saying, "I got caught in the Massachusetts Miracle, so right now a car dealership looks pretty good. I am still doing consulting in metallurgy and actively seek-

ing another teaching position. My three sons are all doing fine: Rich, 21, is working in a computer store; Paul, 19, is a sophomore at Providence College; and Tim, 15, is a high school sophomore. I have been doing a lot of camping in New Hampshire. I also had the chance to talk with many '58ers during the MIT telethon this past October."

If you didn't catch last month's column, please note that Nancy and I have moved to Elkhart, Ind. Your cards and letters should be sent to our new address.—**Mike Brose**, secretary, 1619 Greenleaf Blvd., Elkhart, IN 46514

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Please send news for this column to: **Allan S. Bufford**, secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

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As I write this in late December, I can see that pressing business of the holiday season has kept you from sending notes to your secretary. Were it not for a clipping and brochure from **Ted Kraver**, we would have had a very sparse column.

After working as a strategic planner for the Garrett Corp., Ted later became the founding president of the Sendero Corp., a management software company. Now in Phoenix, Ariz., Ted is the president of Kumm Industries, a company developing continuous variable transmission drive systems. Ted is also a member of the Phoenix Futures Forum, a board member of the Arizona Strategic Planning for Economic Development Project, and a founder of the Enterprise Network, an entrepreneurial support group. Ted places Phoenix's economic development at the forefront of his community interests. Toward that end Ted is helping to develop the Learning Research Institute, a visionary education system that combines research labs, individuals, schools at all levels, and business. Good luck and much success, Ted.

From the *Wall Street Journal* we learn that **Fred Kayne** has resigned as president and CEO of the Far West Financial Corp. in Los Angeles, Calif.

Putting on my class agent's hat for a moment, I urge those who have not yet given to this year's Alumni Fund to please make a contribution before the end of June. Through your support, the Fund is having another successful year and '60 can be proud of the part we are playing in the Fund's success.—**Frank A. Tapparo**, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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30th Reunion

Gadzooks! We've been out for 30 years! This means another reunion with our estimable group of hackers. A favored few will gather on Thursday night (June 6) and prepare for the Boston Pops at the Student Center. Next day we are to have a healthy dose of MIT at Tech Day. This time I am pleased to say biology will play an important role. After learning about AIDS and other pleasant topics, we shall adjourn to the MIT Museum and eat fattening food laced with cholesterol and salt. Saturday there will be a "Techsas" (get it?) barbecue, where the Sunbelt's experience in recession recovery will be a major topic of discussion. Finally, we will have an opportunity to view, firsthand, the harbor that made George Bush famous a couple of years ago. A cruise to major sewage outfalls and power plants is in the offing.

I got a nice note from **Bill Watson** the other day. The gist was that he recently came out of the woodwork to announce that he is alive and well in Mt. Vernon, N.Y. For many years he has been doing consulting work for the big banking and brokerage computer systems on Wall Street. Through most of the 1980s it was a go-go business, but budget and headcount cuts on Wall

Street have taken their toll on consultants too. Bill is now looking for consulting work elsewhere. He says that commercial data-processing technology is pretty much the same regardless of what industry you are serving. Good luck, Bill.

On a brighter note, **Reed Freeman** became vice-president and general manager in Specialty Chemicals at Union Carbide in Charlotte, N.C. In particular he is president of a subsidiary called Union. They are busy trying to figure out how to reduce the risk of PCBs in transformers. . . . **Craig Tedmon** has moved from senior vice-president at Noranda, Inc., in Toronto to executive vice-president (R&D) at Abb Asea Brown Boveri, Ltd., in Zurich. Quite a switch!

Finally, our prolific writer, **Bob Pease** now has a weekly column in *Electronic Design* called "Pease Porridge" (yes). It's a marvelous column written in a wonderfully relaxed manner. Instead of fancy computer-drawn circuits, Bob includes hand-drawn designs that are better and clearer than run-of-the-mill diagrams. They are lucky to get him on a regular basis.

I trust everyone has made their reservations for June and will provide us with far more grist for the column. Happy April Fool's Day!—**Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167

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Emma Root (aka Marcia Aretzeu, '64) writes that **Stephen C. Root** is still at Digital as senior consulting engineer "placing" wires on chips by CAD. Steve and Emma seem to enjoy extracting blood in cutthroat games of SCRABBLE. Steve is keeping fit with volleyball, softball, and taking the stairs instead of the elevator. Son Jonathan (MIT '87, Course III) is looking for a new job in materials science, son David is studying geology, daughter Meredith is a sophomore at Bard College (just south of Albany, N.Y.), and daughter Victoria flourishes in the second grade in Westboro, Mass., where Emma stays busy with church and garden activities.

The November 1990 *Libertarian Party News*, carried the announcement that **Andre Marrou** is already running for the president of the U.S. (vintage 1992) as a potential nominee of the Libertarian Party. Andre was the vice-presidential candidate of the Libertarian Party in the 1988 national election. He is quoted: "I have a passion for liberty. I don't just want to read about it, write about it, debate it, discuss it, and imagine it. I want to live the Libertarian dream. Live in a world of individual liberty and self-responsibility. Because I'm serious about my passion for liberty, I take responsibility for creating liberty, not passively waiting for it." Andre served as Libertarian state representative in the Alaska House of Representatives from 1985-1987. So if you're fed up with the normal fare of the Republicans and Democrats (like the 1990 elections proved in Massachusetts), you have the choice of supporting Andre as the Libertarian candidate. I'm sure at least one other classmate supports the Libertarian Party platform since **Dave Koch** ran on the 1980 ticket as a vice-presidential candidate.

News item from the Manchester, N.H., *Union Leader*: classmate **Allen Charles Hill**, architectural historian from Winchester, Mass., spoke to the Goffstown Historic District Commission on "Houses Hot, Houses Cool—Classical and Romantic Streams in American Domestic Architecture, 1720 to 1915." Allen specializes in the preservation, restoration, and rehabilitation of old buildings. He has degrees from Dartmouth and the University of Pennsylvania in addition to his experiences at MIT and Boston University.

According to the September 20, 1990, edition of the *Wall Street Journal*, classmate **Charles G. Heinrich** has resigned as president and CEO of Sherritt Gordon, Ltd., of Edmonton, Canada. The *New York Times* of September 24, 1990, carried the news that classmate **David W. Martin, Jr.**, is now the head of research and development for

Du Pont Merck Pharmaceuticals Co. Dave was formerly senior vice-president and chief of research and development of Genetech, Inc., in San Francisco, Calif.

Steven J. Brams has published another book: *Negotiation Games: Applying Game Theory to Bargaining and Arbitration*. This latest in Steve's publication career was released in both hardcover and paperback editions by Routledge in November 1990. Steve writes that he will be commuting to Yale to teach during the spring of 1991.

It was nice to get some real news this month. Mary and I are spending the holidays in Gloucester at "Casa du Nord" with the ocean view, as a pleasant change from "Casa du Sud" in Birmingham. Any cards and letters should be sent to: **Hank McCarl**, secretary, Box 352, Birmingham, AL 35201-0352

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As you can see, I'm standing here on my head on this 50-story ledge in a howling blizzard. You may be wondering why. Well, it's just to bring your attention to a special offer we're having here at the class of '63 column. We call it our news-athon. Just for participating you get, free of any additional charge, the chance to share what's new with your classmates. Also, the first five correspondents will receive this high-quality set of 23 super-sharp knives, a regular \$39.95 value. So call now: (301) 750-0184. (Will someone help me in off this ledge?)

Andy Campbell sends a short but newsy letter. He is an applied mathematician for Federally Chartered Research and Development Center, The Aerospace Corp. (Yes, that's the complete title.) They do work for the Air Force Space Division. Andy spends off-work time reading books for Recording for the Blind and plays "a lot of contract bridge." He is also active with the local Association for Computing Machinery. Andy can be reached at 44 Village Cir., Manhattan Beach, CA 90266, or through Internet, campbell@aerospace.aeromg.

Steve Bernstein is still at Lincoln Lab, now as head of the Optical Communication Technology Group. His wife, Stephanie, regularly attends Israeli folk dancing at MIT. Their daughter, Deborah, is a sophomore at Boston University, and son David is an avid high school soccer player. . . **Maurice Lanman** recently became vice-president of engineering at Scott Instruments, Denton, Tex., a technology leader in speaker-independent voice recognition. He is "looking forward to the challenge of growing with this small company as market demand develops over the next few years."



John Castle

I received a few press releases with classmate news. **John Castle**, chairman and CEO of Castle Harlan, Inc., a New York merchant banking firm, has received the William Cullen Bryant Award from New York Medical College. . . **Richard Harris** is now vice-president in the MITRE Corp's Center for Advanced Aviation System Development in McLean, Va. He's been at MITRE about 23 years, having been involved with aircraft collision avoidance systems, airport capacity planning, etc. . . **Carlton Speck** is a faculty member at Lawrence (Mich.) Technological University. He also is a section manager for GM's Research Lab

Electrical/Electronics Engineering Department and has also taught at Case Western Reserve. . .

Tom Gerrity is now a director of Sun Co. of Radnor, Pa.

Now remember folks, this may be your last chance to get these handsome individually-polished, genuine faux crystals, along with your free super-sharp knives and this free six-piece designer luggage set, all for writing in with your class news. Act now, operators are standing by. And I'm still standing on my head on this ledge.—**Phil Marcus**, secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184, Compuserve 72047333

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Bruce Knobe writes that he has moved to the Kendall Square Research Corp., where he is director of Software Engineering. KSR is a start-up company building supercomputers. These are not the easiest of times to be launching a start-up—best of luck!

A newsclipping provided the information that **Bob Weinberg**, biology professor at the Institute, is the 1990 recipient of the Samuel Robert Noble Foundation Research Recognition Award. Congratulations!

The University of Missouri Press announced the publication of *Whistling Dixie: Dispatches from the South*, written by **John Shelton Reed**. The book is a collection of essays authored by John that have appeared in several Southern journals and magazines.

The prepublication reviews were quite enthusiastic; in fact, the *Philadelphia Inquirer* called John "the wittiest scholar to come down the pike in a long time." John is a professor of sociology, adjunct professor of American studies, and director of the Institute for Research in Social Science at the University of North Carolina at Chapel Hill. He has authored, co-authored, or edited eight other books in addition to *Whistling Dixie*.

That's it. Please write.—**Joe Kasper**, secretary, RR2, Box 4, Norwich, VT 05055

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I received a note from **Richard Ayers**, now chairman and CEO of The Stanley Works. Hopefully, I will be able to profile him in a future column. . . **Dick Schmalensee** writes that he continues to enjoy life in Washington as a member of the President's Council of Economic Advisors. Perhaps he would like to make a contribution to the Massachusetts economic scene! . . . I missed connections this month with **Bruce Morrison**, who lost to Lowell Weicker in the race for governor of Connecticut. I hope to profile Bruce in the next issue.

In other class news, I regret to report the death of **Robert Ochis**, who was a patent attorney with General Electric. He died October 22, 1990, in an automobile accident leaving his wife and five children.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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25th Reunion

Not much news this time. All the notes from end-of-year donations will hit next issue. . . **Isaiah Shalom** passed the Massachusetts Bar Exam and was admitted to the Massachusetts Bar in 1989. He is practicing law in Cambridge. . . **Henry Allen White III** is now a member of the National Board of Directors of Recording for the Blind. He also continues as First vice-president at Merrill Lynch.

As I write this, the New Year has just begun—I hope it's treating you all well. This may also be the last chance I get before the reunion to remind you to come. The committee has done a great

job. Let's see everybody there.—**Jeff Kenton**, secretary, 7 Hill Top Rd., Weston, MA 02193

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Richard Cunningham, seeking election as an independent, was involved last year in a three-way race for Connecticut's 27th senatorial district seat. Richard had been elected as a Republican to the State Senate seat in 1978 and was elected to the State House of Representatives in 1984. . . At last report, **Stan Rose** was waiting to hear if his daughter has been accepted to her first choice college; the end of her freshman year would be the year of our 25th reunion. Time does fly! Stan ran the New York City MIT Alumni Telethon, an annual tradition for him. This involves the use of his office facilities for approximately 20 volunteer callers. . . **George Howison** has been promoted to senior vice-president and CFO of Burlington Resources Inc. in Seattle.—**Jim Swanson**, secretary, 878 Hoffman Terr., Los Altos, CA 94024

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Sorry we haven't written much recently but things have been rather busy, and the mailbox wasn't filling very fast. The most time consuming was a criminal case Mike was involved in last fall that had been three years in the making. Fortunately, he was on the prosecution side, which prevailed. The case dealt with two instances of communications satellite jamming that occurred in 1987. The case gets more interesting when it is revealed that one of the "victims" was the "Playboy Channel" and the defendant was an employee of the Christian Broadcasting Network accused of using his employer's equipment. The only primary evidence in the case was a few seconds of videotape of the jamming message, a biblical quote, so the case was very technical. At the courthouse, Mike met Ted Chang, '67, a math/statistics professor at the University of Virginia, who had been approached by the defense in this case to be an expert witness but declined. (Ted managed to get to the Norfolk courthouse anyway to be an expert witness for the government on a case dealing with undersized scallops and whether the government had sampled the boatload of scallops adequately. We don't know how that case turned out.)

We have heard that **Benjamin Guille Cox** has been elected vice-chairman of the board of managers of the Rose-Hulman Institute of Technology. Guille is a partner in the Terre Haute law firm of Cox, Zwerner, Gambill, and Sullivan and has been on the school's board of managers since 1985. . . On the West Coast, **Bill Mack** has joined the management consulting practice of Deloitte & Touche as a senior manager. After getting two degrees from the 'Tute, Bill joined the Bank of America. There he worked up to senior vice-president and director before leaving in 1986 to found Tavistock Capital Corp., a San Francisco investment banking and advisory firm.

The Materials Information Society has selected **John Vitek** as a winner of its annual competition for metallographic exhibits and has given him the Jacquet-Lucas Award for Excellence in Metallography. John is on the research staff in the Metals and Ceramics Division of Oak Ridge.

In High Point, N.C., **Reid Marsh** has been appointed to the advisory board of the local branches of the NCNB banks. Reid is president of Marsh Furniture Co. . . Closer to Cambridge, **John Dehne's** employer was acquired from Honeywell by Loral Corp., but since John's new title is president, Loral Infrared & Imaging Systems, we assume he fared well in the change. . . Also in the Hub, **Stephen Ostrach** is the legal director of the New England Legal Foundation, a pro-business, non-profit public interest law firm in Boston. "We work to advance free enterprise through litigation on behalf of clients who cannot afford private counsel." . . After 11 years at

Columbia Presbyterian, **Dave Seldin** has returned to the Boston area as section head of nuclear medicine at the Lahey Clinic Medical Center in Burlington. . . . **Carol Botteron** recently got a grant to continue her research and expects an MS from Tufts about the time you read this.

With great sadness, we report the deaths of two of our classmates in August 1990. **Richard Young** died on August 2. At this time, the only information we have is that his last address was in Raleigh, N.C. . . . We also received letters from John Rudy, '67, and **Ellen Greenberg** reporting the death of **Rick Rudy** of Cupertino, Calif., on August 26, after a long illness. Rick had been in charge of quality assurance at Laserscope. He was the founder and president of High Tech Gays in Silicon Valley; a founder of BAYMEC, a political action coalition; and was on the executive board of the National Gay and Lesbian Task Force. In addition, he continued to be involved in musical theatre and Gilbert and Sullivan as director and performer. Rick's family has set up a special fund in his memory at MIT to benefit the Musical Theater Guild, successor to the Gilbert and Sullivan Society that he was so active in. You may earmark your Alumni Fund donation to this fund by noting his name on your contribution form. Our condolences to the Young and Rudy families.—**Gail and Mike Marcus**, Co-secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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Paul Beckerman is working with the World Bank in Argentina, specializing in monetary and financial sector issues. Paul writes, "Its current problems notwithstanding, Argentina is a beautiful country with marvelous people, and this makes my work something of a privilege." Paul's wife, Azucena, works in the International Finance Corp., the agency associated with the World Bank that works with the private sector.

A news release reports that Professor **Gregory B. Olson** of the Department of Materials Science and Engineering, Northwestern University, Evanston, Ill., has been named a fellow of ASM International—The Materials Information Society (a worldwide society with more than 54,000 members in nearly 100 countries). Gregory was cited "for research contributions on the mechanisms of martensite formation and transformation plasticity leading to the achievement of new levels for the strength and toughness of steels."

Ora Smith has become the first president and chief executive officer of the Illinois Superconductor Corp., the first superconducting applications company of Illinois. Ora will oversee the development, manufacturing, and marketing of high-temperature superconducting materials, components, devices, and systems. "My mission is to mold ISC into a premier superconducting applications company, manufacturing and marketing electronic and electrical devices that exploit the high-temperature superconducting phenomenon," he said. ISC's first product will be a cryogenic sensor that is the first high-temperature superconductor product of its kind commercially available.

Meanwhile, in the January snows of New Hampshire, I'm putting the finishing touches on my forthcoming book, *Fire from Ice: Searching for the Truth Behind the Cold Fusion Furor*, which will be published by John Wiley & Sons in May 1991. If you think you know something about where cold fusion stands by reading accounts in the general press, think again! Both skeptics and cold fusion "believers" will find eye-openers in *Fire from Ice*.—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Keep those cards and letters coming! In fact, please send us a few. This month, we have only two items to report.

Alex Chu has moved from M/A COM, Inc., to MITRE, where he is a consulting scientist in D90, Strategic Communications, evaluating new circuit designs and their applications.

Karen has also been promoted to deputy editor of the *New York Times* Business Section.—**Greg and Karen Arenson**, Co-secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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20th Reunion

Peter E. Brumme, is senior vice-president for North American sales and marketing at Microcomp, Inc. He was formerly senior vice-president for marketing at Micro American. . . .

Diogo B. Teixeira, is a management consulting partner at Ernst & Young. He will be based at Ernst & Young's Center for Information Technology and Strategy in Boston. He was an executive at BancOne Corp. and was in the transportation planning field with Applied Resources Integrations, Ltd. . . . **Romek Figa**, has patented a device that will allow people to know the name, not just the number of someone telephoning before picking up the receiver. His prototype, TELA-NAME, would retail for less than \$200 and could be sold through phone companies and stores. Romek Figa can be contacted at Box 1343, Hanover, NH 02339.

Lawrence E. Schmutz, is president of Adaptive Optics Associates of Cambridge, a subsidiary of United Technologies Optical Systems. . . . **Nancy J. Rosenfield** lives in Lexington, Mass., with her husband Don, and they have three children—Jennifer (16), Todd (12), and Adam (4). She is working as a software engineering consultant at Endex Technology in Cambridge. Don is teaching at MIT and running the leaders in Manufacturing Fellows program there. . . . **Bruce T. Smith** writes: "After MIT, I got a master's in mechanical engineering from Stanford, spent two years at Berklet in Norwalk, Calif., designing power plants, got bored and went back to school, receiving an MBA from Harvard. From 1976-1979, I was at Detroit Edison working on rate cases. In 1979, we returned to California where I've been working at Pacific Gas and Electric Co. I'm now director of Cost and Service in the Rates Department. I testify in rate cases on topics from streetlight rates to the cost to transport natural gas from the wellhead to transmission lines. I married Ellen Berman the summer after MIT. We have three children—Gabrielle (14), Zachary (12), and Joshua (7), all of whom get better grades than I ever did. I'm looking forward to seeing lots of my classmates at the reunion. In the meantime, Happy New Year!

Leslie Lynn Rahl is vice-president and department head in charge of interest rate risk management (caps, swaps, options, etc.) for Citibank. In April 1989, she married J. Andrew Rahl, Jr. Andy is a partner at Anderson, Kill, a New York law firm. She has two stepchildren who live with her half the time. Kaitlin is now 10 and Stephen is 7. On June 15, 1990, their son, Kevin Samuel, was born. Don't forget the reunion!—**R. Hal Moor-man**, secretary, Box 1808, Brenham, TX 77834-1808

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A healthy salute to the columnist's cap to **Peter Huber**, lawyer, and author, whose article "Pathological Science in Court," was published in *Daedalus*, the publication of the American Academy of Arts and Sciences. I only wish they'd sent it to me; his book *Liability*, if you've not been fortunate enough to read it, was brilliant, pointed, and persuasive.

Mark Liss and wife, Patrice, are the parents of a new little one, Andrew Brian, born March 20. Yours pinfully wonders if proud papa is still bowling. He had a pretty fair hook back on the little-known MIT bowling team. . . . **Howard Harris** is in Harrisburg (where else?), now as an associate director of corporate development for

Pugh-Roberts Associates, Inc.

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Thomas W. Mullen, '86
Thomas G. Kelly
Maurice Glucksman, '85
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Yours sincerely, this December 16, looks back on a most interesting year; one of a new job that has taken me to Germany and Panama, to Omaha, Tampa, and L.A., but puts bread on the table, after all. The kids and the wife are all doing well, and the fish is healthy. At the same time, over 400,000 of my fellow Americans are defending the stability of the world in a far-off land, and our prayers are with them.

Philip Morris and its fellow tobacco companies cost us 390,000 of our fellow citizens this year, including many who never smoked a cigarette, but fell victim to ambient environmental smoke. If you smoke, fellow classmate, quit.—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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Cheerio, Buckaroos! If you haven't lost the weight you gained over Christmas by now... well, neither did I. Leading off the column this month is **Marty Davidoff**, class treasurer, who reports that as of the first of the year he's out on his own, a sole proprietor, working under the name of E. Martin Davidoff, Certified Public Accountant. Way to go, Marty!... Somebody has good public relations connections. From three separate sources, your faithful scribe is informed that **Stephen Barnes** of East Boothbay, Maine, has become the new director of The Rockport Apprenticeship. The cleverly-named apprenticeship is a boatbuilding school in Rockport, Maine, dedicated to the preservation of traditional craft and the wooden boatbuilding art.

A lengthy article in the Kankakee, Ill., *Daily Journal* describes the work of **Peter Grain**, "a superb" neurosurgeon who is performing miracles for patients in the Kankakee area. The article describes one 14-hour procedure Peter performed to remove a lemon-sized tumor from a patient's head. "I am an infant compared to the knowledge we'll have about the brain in 100 years," says Grain. "We take out tumors, clip aneurysms, and remove herniated disks, but we do nothing, really, to affect the physiology of the brain. We're in the dark ages of neurosurgery." However, in the words of one of his patients, "Dr. Grain is an amazing young man."... **Stanley Reed**, a specialist in internal medicine, has become a member of the Methodist Hospital medical staff in Indianapolis.... **Jens Eldrup-Jorgensen** is chief of the Division of Vascular Surgery at the Maine Medical Center in Portland, as well as an associate clinical professor of surgery at the University of Vermont College of Medicine. He has a new baby daughter, Anna, as of last August, and he is "trying to do research on platelet activation."

Alumni fund envelopes came in from a few classmates this month. **John Hixson** is developing affordable housing for the city of Newton, Mass.... From the other side of the world comes a note that **Benjamin Svetitsky**, who moved to Israel three years ago, now has a permanent job (tenure?) in the Physics Department at Tel Aviv University. Says Benjamin: "I feel settled in now, having recently bought an apartment in Rehovot and gotten my first taste (but no the last!) of military service."

Ronald Todd wants you and me to know that he and Jayne recently moved into a new home in Framingham, Mass., and are expecting their first child in March.... **Yee Wah Chin** bought a new place in New York City. Unfortunately, not before she sold her old place. Looking for a "spacious one-bedroom duplex co-op apartment in Greenwich Village?" Contact her at (212) 827-3616. In another direction, Yee Wah spent a week in Europe in June to attend a conference on European Community Competition Law. "It was an enlightening experience. All the lawyers, who spoke Dutch, obviously were also fluent in at least two other languages. The evident will to make this

Tower of Babel work gives me confidence that 1992 will really occur, so that it behooves the U.S. to prepare accordingly." Thanks for the warning.... **Paul Mailman** is pleased to report that in August he and his significant other, Lynn MacDonald, were married. As of October, Paul still worked for Atex in Bedford, Mass., with wary eyes alert for the axe. In attendance as best man at the wedding was **Guy Consolmagno**, now a novice Jesuit brother, due to take his vows in the summer. "He hasn't given up science for religion, though," says Paul. Look for Guy's recently published amateur astronomy book, *Turn Left at Orion*. Paul also has recent word from **Ron Spinella**, who plans to put together a Bexley Hall reunion.

A looong letter from **R. Gregory Turner** closes out this month's diversion. I'm sorry I can't do much more than summarize it here. Greg has had his own architectural practice in Houston for six years now. Five people make up the company at the moment. Greg's first book was published by Van Nostrand Reinhold: *Construction Economics & Building Design: A Historical Approach*. Greg was awarded the MIT Lobdell Award for outstanding service to the Alumni/ae Association in 1989, including serving on the national Alumni Fund board. On the personal side, he says, "I can't wait until my boys are old enough to cut the grass." Along with his wife, Ann, the family consists of Matthew, Alan, and Patty, "2 years old and in need of a father who can say 'no' to her."

Say "yes" to your old pal, Lionel. Write that little note today.—**Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133

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Lawrence H. Summers, formerly professor in the Economic Department of Harvard University, has become vice-president and chief economist of The World Bank in Washington, D.C.

This item in from the November 9, 1990, edition of *Anchor* of Fall River, Mass.: **Sue Costa**, after her MIT degree, obtained a master's of divinity from the Weston School of Theology. She then taught theology for two years at St. Columbkille High School, Brighton, before lending her skills to several homeless-assistance groups. For nine years, she was advocacy coordinator at Rosie's Place, a Boston emergency shelter for women and children. There she assisted clients with housing and health-care concerns, substance-abuse problems, job training, and employment placement. In her years at Rosie's Place, she also worked with a state-funded homelessness prevention program and served on the boards of Project Hope, a Dorchester family shelter, and the Massachusetts Coalition for the Homeless. Inspired by a desire to see improvements in mental health care for the poor and homeless, Sue is currently enrolled in a doctoral program in clinical psychology at the Massachusetts School of Professional Psychology. Best of luck in all your worthy endeavors!

Lila Kobylak Kung dropped me a note to say that she recently gave up teaching to pursue more profitable endeavors. She is working as a marketing consultant for high-tech products. Her current area of specialization is computer-integrated manufacturing, particularly in the process industries. She recently had a book published, *U.S. Market for Process Control Instrumentation*, which is available from the Market Intelligence Research Corp. in Mountain View, Calif. She is currently working on an overview of technological, political, and economic trends impacting the global analytical instrument market for industrial process applications. Says Lila, "Both recent environmental legislation and the improving U.S.-Soviet trade relations are making this an interesting project."

And finally, a nice letter from **Kay Anderson Sieverding** as follows: "David and I had a new baby in July—Thomas. Our 4-year-old Eddie is remarkably unjealous.... **Susie Fuhrman** and Larry Lasky had their first child, Charlie, in June.

We got together in Los Angeles in November.... **Bill Donner** ('73) and his wife Cheryl and two boys visited us in August and we went to a redwood forest.... Dave and I really have our hands full with this entrepreuneuring stuff. Our Elegant Graphic Slide Service is doing the cheapest slide imaging in the country and supporting 35 languages. Our first business, Friendly Plastic, is also doing well. Product sales in 1990 will be about \$4 million—not IBM but great considering how little went into the company. The company that is now manufacturing and marketing our products made a tender offer for our stock, but we and most of the other shareholders turned it down. We are thinking about moving to Minneapolis."

That's it for now. Keep writing!—**Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036, or 18 Montgomery Pl., Brooklyn, NY 11215

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15th Reunion

We are pleased to note that **Mark Halpern** has authored a book: *Binding Time: 6 Studies in Programming Technology & Milieu*. It is a collection of essays by Mark delving into issues associated with Artificial Intelligence.... Professor **Peter Hagelstein** has won the 1990 Award for Excellence in Plasma Research from the American Physical Society.... **Sue Thomas**, MD, is now out in private practice, having been previously at Yale. She is part of group practice in Newtown, Conn.... From **Lee Silberman**: "I have renewed friendships with **Elliot Chartist** who now works at North Shore Community Hospital with my wife and Alan Fisher, '74, who is now at Brookhaven Labs. As vice-president and treasurer of the Long Island MIT Club, I would like to encourage local alums to get active in our activities. Recently, **Bonnie Kellermann**, '72, spoke at one of our dinner get-togethers."

Your secretary had a delightful phone conversation with **Susan** (nee **Fife**) **Dorchak**. She and Fred have two girls, now 9 and 6. Susan took a position at C.W. Post College on Long Island in 1980 in their Computer Science Department. She is now the chairwoman. She moved into computers in 1978, after getting a master's degree from Post in engineering management in 1978 and a short stint in industry. Fred is a patent attorney. They have been living in Westbury, Long Island, for the last eight years.

Raphael Blumkin is now a full vice-president at Chemical Bank, New York. He is an internal consultant at Chemical, involved in measuring staff productivity and recommends staffing levels. These days, it is largely layoffs. As a result, his services are in great demand. According to Raphael, there is no end to the workload. This, of course, has cut into his social life, even though he lives in Manhattan. This is the price one tends to pay for a career on Wall Street.

Richard "Ricky" Farber is another Manhattanite. He left Goldman Saks two years ago to rejoin his old firm, Coopers and Lybrand. He is now doing consulting in his specialty, employee benefits, in the mergers and acquisitions buyer's services area. If anyone has a question about employee benefits plans, Ricky has the answers. The slowdown in mergers and acquisitions activity in 1990, according to Ricky, really has resulted in a comparable slowdown in his area. In addition to the consulting, Ricky is now the vice-chairman for Manhattan, for the MIT Educational Council.

Roy De Meo is vice-president doing quantitative financial analysis for Nomura Securities. He is now married. He told me that our classmate **David Gabii** is a full professor of mathematics at Caltech and that there are now several theorems named after him.

Jeffrey Halis is in the midst of a job switch. When your secretary spoke with him, he was in the midst of setting up his own firm to provide money management and run a hedge fund. He has a great deal of experience in this area, one of

Wall Street's specialized niches. Your secretary, of course, is in favor of setting up one's own business. However, I do have a caveat for any of you contemplating going into business for yourselves: "The boss always gets paid last; hopefully, the best, always the last." I coined this bit of wisdom some time ago, and continue to find it quite true.

Finally, the doings of your secretary. Our speech recognition business continues to move forward, albeit slowly. Inquiries and sales continue to grow for our first product, the Voicebox. You might think that, given a body of technology involving digital signal processing, signal sampling, pattern recognition, and artificial intelligence, we would be deluged with inquiries for technology or product licenses, or that our efforts to seek partners would be successful. I have tried to skew our efforts towards American firms and have largely been disappointed. Instead, the interest in licensing is coming from abroad—Japan and the U.K. It is eerie to be living out what I had previously read about as a problem in the *Wall Street Journal*. As a matter of fact, I am contemplating selling short shares in some American companies who failed to show any imagination or response to our efforts. I fear that these organizations are dead from the neck up and, therefore, are perfect short selling candidates.

Your secretary urgently requests that you send news. We have a significant number of classmates from whom we have heard nothing at all over the last 14.5 years, and plenty of others who have not sent word in a decade. The odds are that you have friends and classmates with whom you have fallen out of touch, where news might trigger the renewal of an old, and very pleasant, friendship. Besides, it never hurts in these economically perilous times to keep in touch with classmates—networking may help you with your careers. Please write or send word of others who have not corresponded. We sorely need the news prior to our upcoming 15th Reunion.—**Arthur J. Carp**, secretary, Voice Recognition Technologies, Inc., 220 Henley Rd., Woodmere, NY 11598, (516) 295-3632, Fax: (516) 295-3632

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Hi! First, a special "thank you" to my SOLE benefactor, **Todd Glickman**, who sent me an MIT sticker for my van. Your efforts and letter are very much appreciated. . . . I also received a letter from **Jim Torma**, who lives with his wife and children in San Antonio, Tex. Jim is still in medical school, and his wife is a nurse. . . . **Randy Wilson**, who is living in Santa Monica, sent a letter along with a recently published poetry chapbook of his. Randy continues to work at MGM as manager of motion picture and television credits, but his real love is writing. Since 1988, he has been writing fiction and poetry exclusively, and one of his short stories, "Connecting," which appeared in *The Boston Literary Review*, has been nominated for a Pushcart Prize.

James Pollock reports that he married Carolyn Sommerich in 1990 and moved to Columbus, Ohio, where Carolyn is a PhD candidate. James is the product marketing manager for IRD Mechanalysis. . . . **Robert Dantowitz** is now vice-president at Index Group, Inc., in Cambridge Center. . . . I had a nice conversation with **Michael Di Novi** today. Mike, his wife Beth, and his cat and dog live in Baltimore. He still works a desk job at the FDA here in Washington. He promises to visit sometime soon.

Our last piece of news comes from a press release from Birmingham-Southern College. **William Gilchrist** has been named a member of the President's Advisory Council at Birmingham-Southern College. He is currently a branch manager of Diversified Project Management, Inc., and he is a past winner of the Karl Taylor Compton prize and the Aga Khan Traveling Fellowship at Harvard.

My thanks go to all those who took time to write. I love reading your letters, and we all en-

joy hearing about our classmates. Please remember that I can't do this column without you, so write soon! e-mail to hertz@ccf3.nrl.navy.mil on the internet.—**Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153

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Gene Allen writes, "I have left independent consulting to take a position as the director for strategic development at the National Center for Manufacturing Sciences. I am coordinating manufacturing research among member companies and the federal government to help ensure that a competitive manufacturing base is maintained in the United States." Gene, wife Kathy, and daughter Katherine are living in Vienna, Va. . . . **Frances Scovil** is now an operations manager at Analog Devices. In her spare time, she's been redecorating her place, and even fit in a trip to a health spa. Frances and her dog, Silly, live in the South End in Boston. . . . Congratulations go to **Deb (Abbott)** and "**Skip**" Page and son Evan who announced the adoption of Emma Wilson, born in October 1990. The Page family is living in Rye, N.H.

I received a copy of an interesting article coauthored by **Janos Pasztor**, "Bioenergy and the Environment." This article examines biomass fuels—wood, animal and crop wastes, and alcohols—the impact of these renewable fuels on the environment, and their uses. Janos is senior environment and development officer at the Secretariat of the United Nations Conference on Environment and Development in Geneva, Switzerland.

Your class secretary and wife, **Diane Curtis**, are busily doing use planning for our farmland, and beginning the design of our house that will sprout out of the ground next spring. Books by Christopher Alexander—*A Pattern Language* and *The Timeless Way of Building*—have made for fascinating reading, as have books about feng shui, the traditional Oriental approach to siting and designing buildings, and books authored by William Mollison about permaculture, the practice of establishing sustainable, low-labor, and energy-efficient food production and habitat ecosystems. . . . Please send your news today!—**Jim Bidigare**, secretary, 322 Central Ave., Newark, OH 43055, (614) 345-8582; **Julie Kocazka Stahlhut**, assistant secretary for Networks, Internet: jstahlhu@hstbme.mit.edu; Compuserve: 76566, 1012

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Greetings, classmates. I know I missed last month's issue—but it was your fault! I received no news from you. Remember, this column is only as good as you make it. Enough scolding—on with the news. . . . **Alan Gaines** writes from his home in Cranston, R.I.: "Seven years of training in New York, two years in North Carolina, and two years in allergy and immunology practice in Rhode Island. My wife Sharon and I have two boys, Ben (3) and Alex (1), who keep us hopping and test my ability to apply all that normal developmental and child psychology stuff I learned in pediatric residency." . . . Alan also sends along a profile of **Gary Isaacs** that appeared in the October 8, 1990, issue of the *New Yorker* magazine. The extensive article chronicled Gary's numerous careers. First, after getting a master's degree in mechanical engineering from the Tute in 1980, he headed for TRW in Redondo Beach, Calif. As a member of TRW's Defense and Space Systems Group, Gary worked on the tracking and data relay satellite, which was the world's biggest and most sophisticated communications satellite. He eventually moved on to end-to-end system tests of other satellites. After four years, he left TRW to get a degree from UCLA's Graduate School of Management, and ended up on Wall Street. He was most recently a vice-president in the Financial Strategies Group of an investment house, in

the division monitoring the S&L crisis. In August 1990, Gary left his job to pursue his lifelong dream—to become a circus clown! He enrolled in Ringling Brothers and Barnum & Bailey's Clown College in Venice, Fla. The article was fascinating, and I hope Gary will write to let us know where he ended up upon completing clown college.

Christopher Rose left Bell Labs Research to join the electrical engineering faculty of Rutgers University in New Jersey. "Lots of work feeding young minds, but it's fun. Now if Sun will only ship the damn computers I ordered!" . . . Speaking of computers, **Lawrence Bodony** writes, "I joined Edsun Labs, a Waltham start-up, two years ago, taking on the PC graphics market through silicon. Also moved into a house in Newton last year and am still getting used to suburbia!" (A note to my past critics: all of the exclamation marks you see have been supplied by classmates. I am no longer providing gratuitous punctuation.) . . . More news from the computer front: **Andrew Kobayashi** "succeeded in getting laid off from Prime, took a three-month vacation on my aluminum parachute, and now works for Camex in downtown Boston. My wife of ten years, our 3 year old son Matthew, and I continue to do well."

William Wood supplied the following good news: "I have managed to stay out of jail since graduating thanks to the love of a good woman (Susan Karash, married May 1986). We just had a daughter, Alexandra Faith, born October 20, 1990 (8 lbs., 20 inches)." . . . While perusing a recent issue of *MacWeek*, I discovered that **Joel West** is the author of a column entitled "Organizational Mac." The by-line features his photograph, so I know it is really him. . . . **Phyllis Koton** got a PhD in computer science from MIT in 1988, specializing in artificial intelligence. Since then, she has been working for MITRE Corp. in Bedford, Mass., and was recently promoted to principal scientist. . . . Also recently promoted is **Thomas Theurkauf**, who is now senior vice-president at Connecticut National Bank in Hartford. . . . Your faithful secretary is pleased to announce that she is once again gainfully employed in New York City. In addition, those of you who have been curious about my change of address last year might be interested to know that I am once again checking off the box marked "single" when I file my tax returns.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

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The **Jay Brandford Septet** was one of three featured performances at the second annual DeCordova Jazz Festival held on Labor Day. As reported in the *Billerica Minute-Man* Jay, a saxophonist, started his jazz career with the MIT Jazz Laboratory. *Metronome Magazine* also recognized his composing talents by calling him "one of the finest arrangers in the Boston area." Jay teaches at the New School of Music in Cambridge and Phillips Academy in Andover. . . . The *Billerica Minute-Man* is also the source of news about **Steven Hall**. Steven, an assistant professor in the Department of Aeronautics and Astronautics at MIT, was named to an endowed career development chair established by Finmeccanica, the major Italian industrial group. He is conducting research in control theory with an interest in the control of flexible space structures and the control of vibrations in helicopters.

Chien Huang and his wife are still living on Long Island, enjoying the proximity to New York City and paying for it via taxes. They have been to Europe and Hawaii this year, and professional conferences have taken Chien all across the country.

Steven Frann writes that he is working as a project leader for warehousing/inventory applications at Healthco International in Boston. . . . **Paul Homsy**, who has already received a medical degree, is now pursuing a master's in public health at the University of Texas. Work consists of

15 hours a week at a county psychiatric clinic and a small number of private clients. In his spare time, Paul still plays squash and has joined the Houston Bicycle Club. . . . I have received news that **Mary (Kathy) Sheffield** has completed her residency in internal medicine and is now employed by Cardio Medical Associates in North Attleboro, Mass.

Two marriages to report. In June 1988, **Jim Scutti** married Bernadette Moran. Jim works for GE Aircraft Engines in Lynn, Mass., where he performs accident investigations and customer support engineering for the engine installed in the Navy's carrier-based fighter aircraft. . . .

David Duehren married Anne Murphy on October 7, 1990. Best man was **Brent Dixon**. Also in attendance were several Sig Ep fraternity brothers including **Mike Myers**, Pat Hines, '81, Tony LaVoie, '81, Mitch Rosenberg, '82, and Dave Bertoline, '83. Ken Porolski, '79, was also present. David is the co-founder of Brooktrout Technology, where he is vice-president of research and development.

On a personal note, my husband, Alan, and I moved to Ann Arbor, Mich., in late October. Until mid-December, I continued to recruit for Purdue University. I am now looking for a job in the Ann Arbor area and plan to take some classes. Please send your news to: **Kim Zaugg**, secretary, 2384 Leslie Cir., Ann Arbor, MI 48105, (313) 665-2365, vayda@drs4330b.erim.com.

81 10th Reunion

Hello everybody! I hope you all are making your final plans to attend our 10-year reunion this June. I look forward to seeing you there.

My mailman isn't feeling the effects of the recession so much this month, thanks to so many of you who have kept him busy! I appreciate the mail and look forward to hearing from many more of you soon!

Donald Jones and his wife Ruth (Wellesley, '81, SM, '87) have been busy participating in fall and winter soccer. They are also enjoying their 2-year-old Great Pyrenees sheep dog, Rigel. Don is still having fun selling machine tools. . . . **Dr. Guy Vachon** is living in Austin, Tex., with his wife Sandra, son Guy Pierre, and daughter Carolyn. The family is busy with assorted jobs and avocations. Guy continues to work as a group leader and likes to bowl, golf, and ski. Sandra works at a local headstart, Guy Pierre plays soccer, and Carolyn plays the violin. . . . **Tom Eccles** is a U.S. navy lieutenant. He returned to MIT to earn his SM in mechanical engineering, SM in management of technology, and naval engineer degrees in 1990. He is currently in Navy Dive and Salvage School in Panama City, Fla. He plans to transfer to Naval Sea Systems Command in Washington, D.C., around the time of this publication.

Victor Miller continues to work as a systems engineer for Local Electronics in Yonkers, N.Y. . . .

Joe Kesselman is working for IBM Research in Hawthorne, N.Y., as part of the team designing ITS (a rapid deployment tool featuring interchangeable, reusable, rule-driven-user interfaces). Joe says that if anyone is going to EXPO '92 in Seville, make a point of seeing how much the information kiosks help you. They will be an ITS application. (IBM is doing them as a "distributed pavilion.") . . . **Dr. Barbara Messenger-Rapport**, husband Ken, and son Nathan are enjoying the mild winter temperatures of San Antonio, Tex. Barbara recently "bumped into" **Byung Choi**, who is currently working as a staff neurologist at Keesler Air Force Base. He is married with a baby girl.

Dr. Andrew Yagle is currently an assistant professor in the department of electrical engineering at the University of Michigan. He recently won the Naval Research Young Investigator Award. He won a presidential Young Investigator Award two years ago. . . . I received an interesting article from the *Harvard University Gazette* featuring **Cumrun Vafa**, one of the world's

authorities on string theory. Professor Vafa earned a PhD at Princeton and has been appointed professor of physics at Harvard.

Finally, I received a newsy letter from **Tom Chang**. Tom was married on June 16, 1989, to Joan Vondra in Rochester, N.Y. Following a full weekend gathering of family and friends, the Changs honeymooned in New England, staying at quaint bed and breakfasts and seeing some beautiful sites. **Rob Close** and his wife, Edna Kung, who reside in Los Angeles, attended the wedding. Congratulations. Tom and Joan are currently living in Pittsburgh, where Tom is completing a body imaging fellowship. Tom writes, "Finally, in June, after all these years, I will have completed my training and will enter the real world."

I look forward to seeing many of you at MIT in June. Please make an effort to attend. It is sure to be a lot of fun and will make for some great memories.—**Lynn Radlauer Lubell**, secretary, 2380 Northwest 41st St., Boca Raton, FL 33431

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Please send news for this column to: **Stephanie Pollack**, secretary, 135 Sutherland Rd., Brighton, MA 02146

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It's the holiday time of year and several classmates have blessed us with the gift of information. . . . **John Piotti** reports that he attended the wedding of classmate **Eric Raman** to Caroline Cox at Mood Hood, Oreg., this past fall. Aside from getting married, the big news for Eric is his planned career switch from electrical engineering to medicine. Other classmates at the wedding included **Miles Friel** and **Scott Williams**. Miles is a real-estate tycoon in San Francisco. Scott works at Stanford, where he's responsible for delivering hardware to NASA for an upcoming shuttle launch. Scott and his wife Kerry are expecting their first child next May. As for John, he reports that he remains "one of Maine's least-known bureaucrats," but that marriage (to his Wellesley sweetheart Susan) and Maine are treating him very well.

We have some late-breaking news on the wedding front as we enter the holiday season. **Alan Taylor** and Leslie Maggy will be wed April 12, 1991. Alan is at Berkeley's business school, and Leslie is a marvelous portrait painter. . . . **Julie Tiao** and Tim Dann, SM '87, have announced their engagement. Julie works for BB&N in Cambridge, and Tim (my former roommate) works for Greenwich Capital Markets in Connecticut. Their offspring will likely be the world's foremost designer of arbitraging supercomputers!

I ran into **John English** at 1990's biggest social event: Noelle Merritt's ('85) going-away party. John is working as an engineer at Polaroid, and has recently earned an MBA. Lisa Robertson, John's wife, is working at a medical software company called IDX. Their second child is on the way.

Four people wrote in while giving money to MIT. . . . **Barry Margolin** is still working at Thinking Machines Corp. in Kendall Square. He says he can still be found on campus at LSC movies and in the Bridge Club. Barry bought a condo a few months ago and enjoys living on the shore of Spy Pond in Arlington. He also notes that he has had terrible luck getting classmates to cough up money during phonathons. . . .

Melanie Parker is a fourth-year resident in urology at the Albert Einstein College of Medicine in the Bronx. She is preparing for a June 1991 wedding. . . . **Ruy Cardoso** took a new position in October 1989 as vice-president and chief actuary of the Automobile Insurers Bureau of Massachusetts. Now we know who to blame, as our comprehensive coverage premiums have just jumped 50 percent. . . . **John Thompson** retired

from coaching the Georgetown basketball team, and is now professor of computational media at New York University Tisch School of the Arts. He has exhibited interactive art at a summer festival in The Hague and the American Film Institute.

Thanks for all the letters! Keep 'em coming.—**Jonathan Goldstein**, secretary, TA Associates, 45 Milk St., Boston, MA 02115

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Steven Larky has left IBM after six years and has started an American subsidiary of an Italian company, Infotronic America. They have five employees developing high resolution display adapters for PCs. Steve is enjoying being at the helm of a small company. . . . **Tanya Segel** is still at the O'Connor group redeveloping regional shopping malls. She married William Kane in October. They met at Wharton while getting their MBAs and now live in Greenwich, Conn.—clean air (compared to New York City), trees, and beaches. . . . **Stephen Baker** is working on a museum project in Seoul, Korea, and a major renovation project for the MWRA in Boston. He is working with **Chris Mungenast** and enjoys working with an MIT classmate. . . . **Paula Hammond**, now a graduate student in chemical engineering, has received the Eastman Kodak Thelophilus Sorrell graduate fellowship.

Mike Landmeier writes from Phoenix. Mike is playing the consulting game nowadays and is still trying to create a product and take it to market. He had a visit from **Paul Bradford** back in November, and the two of them took off for Las Vegas. They made it back to Phoenix (with their shirts) and took off for some hiking, volleyball, and heavy drinking. Mike is living in what he describes as a resort for single professionals, very much like his old Baker House days, with pool parties every weekend.

From Boston or thereabouts, **Howard Reubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), hbr@mitre.org.

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Our administrative secretary, **Stephanie (Scheidler) Winner**, and **Jeff Winner** announce the birth of their daughter, Erin, on November 11.

Stephanie writes that her dogs seem to like Erin, but they are particularly attracted to Erin's dirty diapers. (Yech!) Apparently the baby raising business is hard work, for Stephanie also says that her return to Apple in early January will seem like a vacation. . . . **Megan Elizabeth Donahue**, a doctoral student at the University of Colorado at Boulder, has been awarded a 1990-91 Zonta Emelia Earhart Fellowship. She will use the grant to further her thesis work on observations of distant clusters of galaxies and on a theoretical model to explain the optical emission of gas cooling in those clusters.

Steve Soares electronically brings us up-to-date through the miracle of e-mail. Steve writes that he is living on his own in Framingham, Mass. After leaving Raytheon in August, he is now working for MITRE in Bedford, Mass. He informs us that he and **Dave Wu** had been living together for five years, but they have (finally!) gone their separate ways. Dave has started Harvard Business School and is living on the B-school campus in Boston. According to Steve, **Jerry Knobloch** has also joined the stampede to HBS this past fall. He is living with his wife, Conni, in Cambridge.

Elizabeth Raphael plans to wed Andrew Ross in the spring of 1991. Andrew is a Detroit photographer who attended the University of Michigan. Elizabeth is in her second year of residency in emergency medicine at Detroit Receiving Hospital. . . . **Faruk Bursal** sends greetings to all. Faruk has nearly completed a PhD in mechanical engineering at UC/Berkeley. All that remains, he says, "is to convince my advisor that we have both suffered enough."

Your class secretary has not suffered enough, however. So, please send insults and abusive amounts of news to: **Bill Messner**, secretary, 16 Wildwood Pl., El Cerrito, CA 94530, (415) 234-0232, internet: messner%cmlds6@ucbarpa.berkeley.edu.

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Coast Guard Ensign **Roy Vandermolen** was commissioned upon completion of Reserve Officer Candidate Indoctrination at the Reserve Training Center in Yorktown, Va. He has been a member of the Coast Guard Reserves since July 1976. . . . **Constantine Kriezis**, formerly living in Greece, is now a manager of product development at Jung/Brannen Research and Development Corp. in Boston, Mass.

Carlo Zaffanella was married in June, and he and his wife, Amy, bought a house in Dalton, Mass. They both work at GE Defense Systems Division in Pittsfield, Mass. No kids yet—just a dog. . . . **Ross Dreyer** is enjoying his work at Stratus Computer while living in Marlboro. . . . **Adrienne Ono** is still a "graduate slave" at UCLA Department of Earth and Space Science. She is still working on the Mars Observer. Her husband, **Scott Texter**, PhD '86, is still working on AXAF (X-ray telescope) at TRW. . . . **Richard Herrmann** is working as an exploration geophysicist in the Bakersfield office of Chevron USA. His area of responsibility is the northern Sacramento Valley, California. Richard bought a house about a year ago with a woman he met while at Stanford, and they are trying to learn about the perils and pleasures of homeownership. There seems to be a good possibility that they'll get transferred to Texas, because Richard is trying to figure out how to avoid it.

Daniel Kulp has been working hard toward a PhD in material science engineering. In late September, he attended Mountain Bike School at Mt. Snow, Vt., where he had lots of fun riding the trails and climbing Mt. Snow. Mike Mendolia, '88, is a Penn student in his department. . . . **Sergio Ajuria** is still at MIT, starting his ninth year, and almost ready to complete a third degree (SB '86, SM '89, PhD '91?). He got married last August 4 to Stephanie Easterday, a Wellesley grad ('88). . . . **David Altshuler** is in his fifth year in the Harvard MD/PhD program. His research focuses on the molecular mechanisms controlling one aspect of brain development. He was married to Jill Suttnerberg (Harvard, '87) last August 5. He met Jill on an Amtrak train coming from the wedding of Mark Brown, '85. At Dave's wedding were **Ray Schmitt**, **Karen Wohl**, **Andy Chess**, **Lary Ward**, '85, **Joe Parrish**, '85, **Connie Cepho**, '82, **Cliff Tabin**, '84, and **Ed** ('57), **Mitch** ('92), and **Jill** ('92) Roberts. Ray Schmitt ran the New York Marathon on November 4 and, like most first timers, hit the wall around the 21st mile. But Ray preserved and was still able to finish in a reasonable time. Congrats! I had dinner with Ray in New York City in early December after he finished a full day's work at Morgan. Karen was in Dallas on business so I missed her. I actually caught Karen the last time I was in New Jersey, and we had \$9 hamburgers at the base of the World Trade Center. **Andy Chess** has shown up on the missing classmates list, so any of you who attended Dave's wedding please drop the alumni/ae office a line on his whereabouts.

Scott Musinski will graduate from medical school (University of Connecticut) in May 1991. He spent August 1990 in Poland. . . . **Brian Ralston** attended medical school at University of Virginia and is now in his first of a family practice residency in Madison, Wis. Anyone who thought Boston winters were cold is welcome to visit for a new experience in freezing. (As Brian wrote his note to me on December 23, it was -16 degrees without windchill factored in!)

Karl Tucker had a huge party that I, unfortunately, was not able to attend (again, and I got almost three days notice this time). Karl is en-



Brian Brenner, '82 (right), senior structural engineer at Parsons Brinckerhoff and winner of the 1990 William Barclay Parsons Fellowship, was this year named a finalist for the 1991 award. He shares the honor with **Martin Hawkes**, a geotechnical

engineer and colleague on the Boston Central Artery project, and their research will use artificial intelligence to include long-term conditions in the analytical process traditionally used to design bridges for short-term, initial-stress conditions.

gaged (to be married). Congrats! He came out to LA because **Brian Miller** was coming to visit. We all went to a TexMex place in Santa Monica where Gary Wynezter, '85, met us with his fiancée. Talk of **Bismarck** came up and I hear that Bis has a very interesting story to tell us. Maybe next issue. Karl said he'd heard from **Rich Maurer** who, as part of the real Air Force, as opposed to Karl and I, was putting in his time in the Middle East. However, Rich was luckily sent home for the holidays. Bad news is: he may have to back.

That's all folks. Keep in touch.—**Mary C. Engbreth**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (213) 376-8094

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I attended the MIT Alumni/ae Christmas Party in New York City and met some classmates. **Hal Cohen**, and **Cynthia Tronco** were there. Hal is working for an engineering firm, and Cynthia is a senior program analyst at Nomura Research Institute America, Inc., in applications development. They promised me information, so look forward to a full update on East Campus '87 alumni/ae. A new MIT young alumni/ae club is being formed in New York City. If you're in the area, join the exciting events!

Navy lieutenant **Ed Savard** was promoted to his present rank while serving aboard the aircraft carrier U.S.S. *Enterprise*, homeported in Norfolk, Va. . . . **Jerald Tracy** is working in Chicago for O'Connor and Associates. . . . **Edison Wong** is in his fourth year of medical school at Columbia University's College of Physicians and Surgeons. He is expecting to receive an MD in May 1991. . . . Congratulations to **Andrew Ferencz** on his engagement to Karin Holst (Wellesley, '88). Also, Andrew recently left a start-up company to join Computer Products, Power Conversion in South Boston. . . . **Michael Decker** is working as a software engineer at Jung/Brannen Research and Development Corp. in Boston. Mike made it to the LIP-NOSE Holiday Party in early December.

Congratulations to **Grace Ueng**! She recently became engaged to Patrick Trombetta, who graduated from Harvard Business School this past spring. Grace is in her second year of Har-

vard Business School after spending a summer in Hong Kong working for Time Asia.

John Gawlik writes: "It's been a busy three years since we graduated from MIT. After being commissioned an Army lieutenant, I was sent to Nuremberg, Germany, as the chemical defense officer for the Combat Aviation (helicopter) Squadron of the 2nd Armored Cavalry Regiment. The squadron patrolled over 450 kilometers of W. German/E. German and W. German/Czechoslovakian border. The border disappeared when the "Evil Empire" crumbled. The change in the border is amazing. I've visited E. Germany and Poland, and things are bad over there.

"Our mission now made obsolete by the historical changes, President Bush sent us and the entire Corps (half of the U.S. Army/Europe) to Saudi Arabia. I am now at a Saudi port waiting for our vehicles to arrive. My job now is the decontamination platoon leader for the regiment's chemical defense company."

Best wishes to John and all the MIT grads serving our country. Please write to me at: **Stephanie Levin**, secretary, 393 West End Ave., Apt. 8B, New York, NY 10024, (212) 595-3172

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Tupper Hyde has moved from Boston to Chickasha, Okla. Tupper completed his work at MIT in space structural dynamics and control research. He got his orders from the Army in August and will be stationed at Fort Sill with III Corps Artillery. He and Laura (his wife as of June) expect to be living in Oklahoma for about three years. . . . **Chris Cook** was transferred to a Naval Air Station in Brunswick, Maine. He is about to start his first deployment as a navigator on P-3 aircraft with Patrol Squadron 26. He will be going to Roosevelt Roads, Puerto Rico, and Lajes, Azores. Navy Ensign **Timothy Benner** recently reported for duty aboard the destroyer U.S.S. *Radford*, homeported in Norfolk, Va.

Mary Lou Ravese has been taking full advantage of being based in London and has been traveling a lot, most recently to Budapest and Hungary. She will probably be working in London until March. . . . **Giancarlo Filippazzo**

worked one year with the European Space Agency in Holland and returned to the U.S. in September 1989 to get his master's in aero/astro from Stanford. He expected his degree in December 1990. He plans to return to Europe afterwards. . .

Connie Kim is currently attending the University of Texas at Austin after working in LA for Rocketdyne for two years.

Michael Gaidis is in his second year as a grad student in Yale's applied physics program. He just got married in October to Denise Jodoin. . .

Alison Walsh McCarty received an MBA from Harvard in the spring of 1990. She is now working as logistics manager at Teradyne Connection Systems in Nashua, N.H. She married Mark McCarty in July 1988 and was expecting her first baby in December 1990. . . **Reginald Tucker** is currently working for HP in Andover. He takes part in design and development of ultrasonic diagnostic instruments. He recently got engaged and plans to be married in the summer of 1991. . .

Ernest Prabhakar is appearing in the play, *Rosencrantz and Guildenstern are Dead* with Mike Malak, '89. He is also starting research on lattice gauge theory.

Many thanks to **Kevin Oliveira**, who writes with lots of news. First off, he has quit his job as an environmental consultant in northern Virginia and is now going to law school at William and Mary in Williamsburg. He enjoys being only one hour away from Virginia Beach. . . **Hey Jin Kong** is having a good time at the University of Virginia Medical School in Charlottesville. Apparently, she has been going to a lot of UVA football games. . . **Aggie Kim** finished a master's in mechanical engineering at Berkeley and started working at Ford in Detroit in October. . . **Gail Sadlo** is in Seattle working at Boeing on new projects and is going to school part-time at the University of Washington. Her old roommate, **Livia Zien**, is getting married in September 1991. Livia is currently in Manassas, Va. . . **John Zink** got married to Eileen Murphy, '89, in October.

As for me, I just returned from spending the holidays with relatives in Taiwan. My trip was so short I didn't even have time for jet lag! Hope to hear from more of you next month and thanks to all who've written.—**Grace Ma**, secretary, 545 E. 1st Ave., 9H, New York, NY 10016, (212) 545-7950

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It's a New Year's Eve deadline this issue, and there has been a lot of mail this time! I hope everyone had a happy turn of the decade.

David Wright received his Wings of Gold and was designated a naval aviator this past October. David's training included studies in engineering and navigation, training flights in simulators, aircraft familiarizations, basic and advanced instrument training, extended navigation flights, and landings aboard aircraft carriers.

Catherine Rocchio reports that she attended the wedding of **Eileen Murphy** and **John Zink**, '88, last October 27. Catherine says: "It was a great wedding—a beautiful sunshiny crisp autumn day, and the wedding reception was totally entertaining with an Irish Band, bagpipe players, and Irish clog dancing and jigs. I saw lots of MIT people there, including a bunch of my Alpha Phi sisters: **Beth Fellingham** is working out in California doing 6.111 stuff and she totally loves her job in California! . . . **Jen Felch** is in Seattle doing software engineering. . . **Carolyn Zehner** was there, she actually managed to break away from the hectic life of JP Morgan in New York City, and **Jen Lloyd** broke away from working on a master's thesis at MIT to join the crowd! There was a big Next House crowd there as well. . .

Mary Jo Brigante and **Jane Fisher** were both bridesmaids to Eileen. . . I also saw one of Eileen's soccer buddies, **Sandy De'Vincent**, although she has a new last name now that I don't know—she got married this summer. She is now working on a PhD in materials science in Ohio on a grant from NASA and really seems to

love it." Carolyn was recently recruiting at an MIT job fair. I ran into her and **Karen Gold**, who is also engaged and is finishing up at MIT in January.

Laura Ryzowicz married Mark Rapacioli, '87, last August 4. **Lori Aronson** was the maid of honor. Laura is working at Textron Lycoming analyzing cooling systems for aircraft engines. At work, she was able to attend several seminars on finite element modelling. . . **Andy Singer** has become engaged to **Cathy Suriano**, '88. . . **Lisa Schwartz** and **Rob Carskadden** are engaged. . . **Ron Dagostino** and **Sheryl** have become engaged, after five years of dating. Ron and Sheryl are planning a spring 1992 wedding (never rushed before, so why now, Ron says). Currently, they are both living in Boston and are very happy.

Curt Jones is homeported in Guam on a Navy supply ship and dropped a card postmarked from the U.S.S. *San Jose*. He is in the Gulf (United Arab Emirates) and reports that he is drinking beer with the Belgians there, diving, and working 90-100 hour weeks. "Still alive and hoping to stay that way." I'm making an exception on printing addresses for our classmates in the Gulf. You can write Curt at: U.S.S. *San Jose* AFS-7, FPO San Francisco, CA 96678-3036.

George Roscoe also dropped a line from the Gulf. George went to the Basir School at Quantico, Va. and from there continued with three months of classes specializing in communications. He then went off to the 1st Marine Division Communications Company. Just after two weeks there, he received orders to be the communications officer for the 1st Combat Engineers Battalion (1STCEB). So George has had the responsibility of signing for almost a million dollars and reviving a platoon whose previous platoon leader had been relieved. Just three months after that, he was sent over to Saudi Arabia, where he has been since August. They've been digging in and preparing defensive positions. George wonders what will have transpired by the time this gets published. You can write George at: 2nd Lt. G.M. Roscoe, H&S Co. 1STCEB, FPO NY, 09503-5519.

Marcia Smith moved out to the Bay area and is doing biology research at the VA Medical Center in San Francisco. **Doris Lin** was out in October visiting her and painted the town red with Guanuah Pratt, '90. Doris is still living in Boston. . . Also in Boston in **CJ Mallion**. CJ is working in one of MGH's biology labs, and is seriously considering grad schools. . . **Tim Steele** is working at NCR in Atlanta, Ga. He'll be switching departments from operating systems to test engineering.

Dave Miller is at Stanford. . . **Jean Kim** is living with Marcia and will start her new job at Dynamic Graphics. Jean ran into **Yon Chang** at the opening of *Fantasia*. . . **Tom Tatlow** is working at DEC and living in Cambridge. . . **Carlos Barreto** is in Michigan working with Ford. . . **Vicki Afshani** is at UPenn med school in her first year. . . **Mike Edmunds** works for Verity in Mountain View, Calif. . . **Illy King** works at Maxim in Sunnyvale, Calif. . . **John Buck** is in the Boston area working with LCS.

Allan "Ziggy" Perzigian writes with some news about what he has been up to. Before leaving Boston, he was the manager of Crossroads, where many MIT people are found Wednesday nights enjoying the free pizza. Alan got **Tali Tamir** working there as a bartender. Alan headed out to California in September to find a "challenging career in aero/astro." While he was out there, he bumped into fellow Pi Lam brothers **Alan DiCicco** and **Howard Eisen**. They are both working at JPL and doing pretty well (Bass Ale in the fridge, by Alan P.'s definition). Alan D. is planning on returning to grad school soon. After several trips to California, dozens of interviews, hundreds of resumes, Alan was offered a job giving horseback riding tours. So, back in New York, he came up with an idea to start his own consulting company to the bar business. "I'm giving it a shot (excuse the pun)," he says; let us know

how things turn out, and best of luck.

Karl Dishaw dropped some e-mail to report that he is going to control weather satellites out of Fairchild AFB, Spokane, Wash. Karl's specialty training starts in January, and he will be reporting to Fairchild in April. Karl also writes that **Mike Finck** is still in pilot training in Texas and will move up to flying T-38s after Thanksgiving. . . **Rosanne Park** is working at Objectivity, Inc., a start-up company in Menlo Park, Calif. Rosanne loves her work so far. . . **Olaf Bleck** is working as a research scientist in the AI Lab Mobile Robotics Group.

I ran into **David Goldstone** and **Curtis Chen** at the AI Lab holiday party. Both Dave and Curtis are finishing up MS degrees in January. Dave has had a change of plans and will work for IBM for a few months before going on to law school in September. **Leon Balents** and **Barbara Howe** were also at the party. Barbara and Leon are engaged and are planning to wed in Montana next summer. Barbara is finishing up an MS in the AI Lab, and Leon is studying physics at Harvard. I'll also be finishing my MS, and will move on to the Advanced Network Architectures group in LCS to start hunting around for a possible research topic.

Thank you everyone for all the news this month, and please keep writing.—**Kerry Houh**, secretary, 14 St. Paul St., #1, Cambridge, MA 02139, (617) 661-1691, e-mail: tripleh@athena.mit.edu

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Mark Edelson has graduated from the Basic Civil Engineer Corps Officer Course. This was a two-month course in Port Hueneme, Calif., where Mark received instruction on engineering management, and Naval organization. Other topics he studied included civilian personnel management, personnel administration, Navy industrial funding, shore facilities planning, and construction battalion operations. . . **Elisabeth Stock** has been serving as a Peace Corps physics and chemistry teacher in Ghana, West Africa. She says, "I have found my teaching experiences to be among the most rewarding and challenging I have had. I am glad to be teaching math and science in Africa and in return learn about African culture."

David Plass writes that he is working in lower Manhattan as a software engineer/consultant for JYACC—Just Your Average Consulting Co. He works just a few blocks from South Street Seaport and the New York Stock Exchange. David mentions that he has a new hobby—amateur astronomy. He goes once or twice a month to a observatory 30 miles north of New York City to observe with an astronomy club. Over the summer, David and **Sheila Farooki** went back to visit the Institute and saw **David Martin** as well as undergraduates at New House. In October, David and Sheila went traveling again. This time they drove down to Philadelphia.

Hyun-Ju Vega is graduate student in mechanical engineering at the University of Texas at Austin. . . **Liz Quinn** is studying at the University of California, San Francisco Medical School, and **Sherry Huang** is studying at Albert Einstein College of Medicine.

Feroze Deen writes from California to say that he's enjoying the sun and fun out at Stanford. He's focusing on technology and policy studies in the engineering-economic systems program. Other people studying at Stanford include **Rick Marks**, **Walter Chung**, **Mike Dorsch**, **Chris Massa**, **Jose Stevens**, and **Kedron Walcott**. Feroze mentions that he's also run into **Mike Ni**, **Cindy Mok**, and **Gerry Lukpat**.

At the annual Baker House holiday party on December 1, I ran into many people from our class, including **Ken Battige**, **Desmond Davis**, **Beth Kulas**, **Jean Liu**, and **Billo Naravane**.

Well, that's it for now. Keep those letters coming.—**Ning Peng**, secretary, 409 Angyle, Mineola, NY 11501, (517) 877-0444

I CIVIL ENGINEERING

Alan MacGregor, SM '74, writes: "I am a principal in the environmental consulting firm of ERM, Inc., based in Exton, Penn. I direct the hazardous and solid waste program as well as the siting and permitting of new industrial facilities. I live with my wife, Sue, and children, Ian, 9, Ross, 7, and Hannah, 2, in an 1812 vintage farmhouse in Unionville, Penn. . . . **Sam S.C. Liao**, PhD '86, sends word: "I have recently been promoted to professional associate at Parsons Brinckerhoff. I have also been appointed to serve on the editorial board of the *ASCE Journal of Geotechnical Engineering*. . . . **Peter K. Kitanidis**, PhD '78, was recently promoted to professor of civil engineering at Stanford University. . . . **Eric Nichols**, SM '85, reports: "I was recently promoted to senior project engineer at Weiss Associates in Emeryville, Calif. I am currently working on groundwater contamination problems with the distinguished Dr. Jacob Bear." . . . **Richard A. Schlumpf**, SM '66, writes: "I am president of Island Structures, Inc., a design/build firm located in West Islip, Long Island. The company specializes in pre-engineered metal buildings and has recently completed an \$8 million solid waste recycling facility at a landfill that was mandated by the state to close."

Jonathon Goldman, SM '84, sends word: "I am a project geohydrologist at Kennedy Jenks Chilton, Inc., consulting environmental engineers and scientists. I am a registered civil engineer in California and Arizona where there is a semi-infinite quantity of Superfund and related work. I am happily married to the lovely Donna (Emerson College, 1984). Friends welcome—plenty of room." . . . When he finished his degree last August, **Anthony O. Lee**, PhD '90, moved to the Dallas/Ft. Worth area to take a job as an operations research consultant with American Airlines. . . . **Sadaaki Kuroda**, SM '67, writes: "I am now working as an executive VP for Japan Railway Technical Service, the sole agent for international technical cooperation of Japanese Railways Groups (formerly Japanese National Railways). The service of our association covers the pre-feasibility study, feasibility study, the master plan, detailed design, supervision of construction, modernization, and training in every field of railway transport including intercity and urban transport. On-going projects of our association include integrated planning of high-speed railway in Taiwan, preparation of master plan of Bolivian National Railways, improvement of railway transport of Jakarta, improvement of urban railway transport of Kuala Lumpur, Malaysia, etc."

Leon Ru-Liang Wang, ScD '65, reports that since last fall he has returned to full-time teaching and research in the Civil Engineering Department at Old Dominion University in Norfolk, Va. . . . **Harry N. Wallin**, SM '37, sends word from San Mateo, Calif.: "Just want to say 'hello' and that I'm well and enjoying retirement, especially playing golf and traveling. I get involved in fund-raising activities for scholarships for budding engineers and scientists. My wife, Esther, is also in excellent health and is enjoying her retirement. Having retired from the U.S. Navy as a rear admiral in the Civil Engineer Corps and from Bechtel Corp. as an executive engineer, I am following events in the Middle East with considerable interest." . . . **Eva Lerner-Lam**, SM '78, reports: "I'm serving as a gubernatorial appointee

on the New Jersey Transit Board of Directors and I'm chairing a specialty conference jointly sponsored by the American Society of Civil Engineers and the Institute of Transportation Engineers entitled, 'Implementing Regional Mobility Solutions.' The conference will take place at the Meadowlands in N.J. from May 6-8." Lerner-Lam and her husband, Art, were expecting their third child at the time of this writing.

Miguel P. Velez, SM '57, writes that after devoting 25 years to the highway construction business, he has established his own engineering consulting firm called Miguel P. Velez and Associates located in San Juan, Puerto Rico. He is interested in contacting his civil engineering classmates from '57. . . . **Antoine (Tony) E. Naaman**, PhD '72, spent 1990, his sabbatical year, in Germany. He received a Senior U.S. Research Scientist Award from the German "Alexander Von Humboldt" Foundation. . . . **Thomas S. Maddock**, SM '51, writes that he is still the chair/CEO of Boyle Engineering Corp., headquartered in Newport Beach, Calif. Boyle is ranked among the 100 largest engineering firms in the U.S. by *Engineering News-Record* magazine. It has offices in eight states and a large project office in Cairo, Egypt. Maddock retired from the Naval Reserve in 1985 as a rear admiral in the Navy Civil Engineer Corps. . . . **Juan C. Marquez**, SM '81, reports: "I am currently general manager of Aerotutuy, a Venezuelan airline specializing in tourism to exotic destinations in the national parks of the country. These include Canaima with Angel Falls, the highest waterfall in the world at over 3,000 feet; the paradisiac Archipelago of Los Roques, with some of the most beautiful Caribbean Islands; as well as the Amazon Jungle."

Jorge Graells Fernandez, SM '77, sends word: "I'm now starting my seventh year as CEO of Institut Cerda, a non-profit consulting organization that has expanded to a 35-person permanent professional workforce with annual sales of more than \$4 million. Institut Cerda has become known worldwide for its intelligent buildings, value-added services, broadband communications, hazardous waste management and cleanup, hospital waste disposal, industrial logistics, and commercial distribution. Among other projects, we are currently conducting seven large-scale multiclient projects. Based in Barcelona, the Institut has opened an office in Madrid and plans to open another in Brussels within the year." . . . **Alex C. Scordelis**, SM '49, who recently retired as professor of civil engineering at the University of California at Berkeley, was awarded the Berkeley Citation, the campus' highest honor, at the College of Engineering 1990 commencement. The citation is presented in lieu of honorary degrees to pay tribute to those who have made exceptional contributions to the university and to their fields. Known for his outstanding teaching ability, Scordelis is an international authority on long-span bridges, large thin-shell roof structures, and analysis of concrete systems. He is a member of the NAE, held Berkeley's Nishkian Chair in Structural Engineering, and earned many of the most prestigious honors of the ASCE.

Alfred E. Wechsler, ScD '61, senior VP and chief professional officer at Arthur D. Little, Inc., in Cambridge, has been elected a director of the American Institute of Chemical Engineers (AIChE). Wechsler is one of four new members of the governing council of the 50,000-member society. He will serve a three-year term that began January 1, 1991. . . . **Joseph J. Rixner**, CE '68, has

been named 1990 Engineer of the Year by the Rochester, N.Y., section of the American Society of Civil Engineers. Rixner is the managing partner of H&A of New York, a geotechnical engineering and environmental consulting firm, and a principal of its affiliate Haley & Aldrich, Inc., in Cambridge. "In his 22 years with H&A, Rixner has been involved in a broad range of geotechnical engineering and environmental geoscience projects including building foundations, highway bridges, rock tunnels, urban mass transit projects, regional shopping malls, military bases, water and sewage treatment plants, landfills, groundwater supply studies, and hazardous waste investigations," states a company press release.

William A. Moylan, SM '80, has been named to the faculty at Lawrence Technological University in Southfield, Minn. Moylan is a lecturer in the university's College of Engineering. He is also a lecturer in the MBA program of Lawrence Tech's College of Management. Moylan is also a project management consultant for Management Technologies, Inc. . . . **James P. Gould**, SM '46, a partner at Mueser Rutledge Consulting Engineers of New York City, has been elected to the grade of honorary member of the ASCE by the society's board of direction. Gould was cited for his work in the field of geotechnical and foundation engineering. Gould, an expert in the evaluation of prototype performance (the application of soil and rock properties to foundation design and engineering geology), has acted as a consulting engineer on a number of transportation and foundation projects. Since 1966, he has been responsible for the geotechnical investigations for the Washington, D.C., Metro and for the Battery Park City site in Manhattan. Other consulting assignments include the MBTA Boston Red Line Extension, the Los Angeles Subway Construction Management, the Channel Tunnel between England and France, and the Super-Collider tunnel in Dallas.

The Alumni/ae Association has been notified that **William Enkeboll**, ScD '47, of San Rafael, Calif., died on November 10, 1990, and **Colonel John A. Morrison**, SM '40, of Boca Raton, Florida, died on July 20, 1990. There was no further information provided.

II MECHANICAL ENGINEERING

Frank Tai, SM '80, writes: "I founded a new company, Technology Advancements, Inc., in May 1989, to provide aerospace engineering consulting. Principal customers are TRW, Inc., and Hughes Aircraft Co., but I hope to be expanding to all major aerospace corporations in southern California soon. Currently I have 10 employees and actually made a profit in the first year of business!" . . . **Capers McDonald**, SM '76, sends word: "Effective October 1, 1990, I was promoted to president of Spectroscopy Imaging Systems Corp. (SISCO), a joint venture of Siemens Medical Systems (in Germany) and Varian Associates (in California). My wife, Marion, an attorney with Morrison & Foerster, and I live in Los Altos, Calif., with our 2-year-old son Adam. . . . **Jim W. White**, SM '80, reports: "I am the founder and president of Ocean Systems Research, Inc., in Annapolis, Md. The company designs and builds prototypes for DOD and the marine industry. Recent projects include quiet submarine pumps,

waterjets, parametric sonar, arctic ice penetrators, and remote control cameras. After 21 years in the Navy, having a business like this one has been quite a change. Like a roller coaster—sometimes great fun, sometimes terrible!"

Frank J. Heymann, SM '53, sends word from Winter Springs, Fla.: "I retired last April after 36 years with Westinghouse Electric Corp. in its Steam Turbine Engineering organization. I'm continuing active membership in ASTM Technical Committees G-2 and E-33. I'm currently leading a revision effort for ASTM method G32 (vibratory cavitation erosion test) and writing an article on liquid impingement erosion for a new volume of the *ASM Metals Handbook*." . . . **David Domrowski**, SM '83, writes: "My wife Nancy and I enjoy the company of our first child, Christopher Michael. I'm employed as a manager of Manufacturing Automation at GE Aircraft Engines. Nancy is in early retirement (for now) from her profession as a free-lance court reporter throughout Cincinnati. How about the rest of you from those 5th floor LMP get-togethers writing in and telling what you're up to?" . . . **Robert A. Sutton**, SM '72, reports: "After a variety of product engineering assignments at Caterpillar, Inc., during a 20-year career including responsibility for engineering analysis and CAD software, I was appointed product manager for large track-type tractors in 1990. This assignment includes profitability, sourcing, pricing, new product development, product design, and process planning responsibility for that product line."

Chuck R. Cornell, SM '69, sends word: "I am VP and principal of DAI Technologies in Lisle, Ill., a firm specializing in development of electronic control systems for clean diesel engines and alternate fuel engines." . . . **William T. Townsend**, PhD '88, writes: "I was married to Julianne Barrett on September 3, 1989, followed by a wonderful honeymoon in Paris. We live in Somerville, work in Cambridge, and plan to stay in the MIT area for the long term." . . . Lieutenant **Mark J. Olechowski**, SM '90, has graduated from the Navy's Engineering Duty Officer School. During the five-week basic course, Olechowski was provided with training in plans, programs, policies, and procedures pertaining to the lifecycle engineering of Navy ships and systems. . . . **Sadik Kakac**, SM '59, professor and graduate program director in the Department of Mechanical Engineering at the University of Miami in Coral Gables, Fla., has been elected to Fellow grade by ASME. Kakac is an internationally recognized scholar in the area of heat transfer and fluid flow. He is one of the founders of the Department of Mechanical Engineering of the Middle East Technical University in Ankara, Turkey, and served as head of the Turkish Atomic Energy Commission in Ankara from 1978 to 1980.

Peter J. Philiou, '51, a member of the Mechanical/Manufacturing Engineering Technology faculty at Wentworth Institute of Technology, was the recipient of a \$1,200 Faculty Professional Development Program award from the American Society for Engineering Education for the study of "Laser & Optics for Applications" at MIT. . . . **Morton Grosser**, SM '54, has written his seventh book: *The Fabulous Fifty* (Atheneum, 1990). A book-jacket blurb sums up the plot: "In the summer of 1921, fourteen-year Sol seeks independence from his family and his South Philadelphia neighborhood and joins his pals in their obsessive scheme to get to the World Series by clipping newspaper coupons." . . . MIT students **Marc Filerman**, '88, **Paul H. Moncevicz, Jr.**, '89, and **Peter Maloney**, SM '90, have received a \$750 Silver Award in the graduate division of the James F. Lincoln Arc Welding Foundation's 1990 Pre-Professional Awards Program. The national program, which recognizes excellence in college-level engineering research and design, awarded a total of \$15,750 to undergraduate and graduate students across the country. The MIT team's entry describes their design for "An Automated Armature Deburring Machine." The work was complete as part of an Advanced Engineering Design



J.J. Rixner

N. E. Paton

course under the direction of Professor Mark Jakela.

Frazer D. Punnett, SM '34, of Cedar Mountain, N.C., died on September 2, 1990. Punnett was born in Toronto, Canada, but lived most of his life in Rochester, N.Y. He had retired from the Xerox Corp. in Rochester. . . . **Hal R. Terwilliger**, SM '33, of Morristown, N.J., died on August 17, 1990. Terwilliger was a professional engineer with Allied Chemical Corp., now known as Allied Signal, for over 36 years, except for a hiatus of four years when he worked for Standard Ultramarine Co. of Huntington, Va. He retired in 1972.

III MATERIALS SCIENCE AND ENGINEERING

John Zotos, MTE '67, writes: "I have had a busy year speaking to various groups, etc. In May I was the main speaker at Northeastern University's College of Engineering Banquet and my topic was 'Engineering Tales.' In July I addressed an audience at the Museum of Transportation in Larz Anderson Park in Brooklyn on the subject of 'The Design of Motor Vehicles: Past, Present, and Future' during their Auto Design Week Celebration. This fall I am directing five information seminars for parents and potential engineering students at NU's College of Engineering for the Mechanical Engineering Department. I am in my 31st year of full-time teaching at NU." . . . **Phillip H. Smith**, MTE '52, sends word: "I spent a month on the campus of the Dalian Institute of Technology as dean of the Senior Executive Program for the Peoples Republic of China's Ministry of Science & Technology. One member of the faculty was Dick Douglas, who lectured on entrepreneurship and start-up companies, a stellar hit with the Chinese technocrats!"

News from **Neil Paton**, PhD '69: "I have accepted a new position as VP for technology at HOWMET in Whitehall, Mich. HOWMET is a worldwide producer of turbine engine components. I had previously been with Rockwell International as a director at the Rockwell Science Center in Thousand Oaks, and then as a director of Materials & Mechanical Engineering at the corporate offices in Pittsburgh. More recently I have been with the Rocketdyne Division in Canoga Park, with responsibility for future space propulsion systems materials and structures such as the national aerospace plane. I am leaving Rockwell after 22 years and at HOWMET will have overall responsibility for new technology at the corporate labs in Whitehall." . . . **Ray K. Robinson**, ScD '73, sends word: "I recently formed Inland Northwest Ventures Partners, Ltd., a seed capital partnership whose purpose is to form a \$30-50 million venture capital fund. An associate and I are two of the three managing general partners of the proposed fund. A search is underway for a qualified third venture capitalist for the fund. I am also president of Xcel Ventures, executive VP of the R.L. Ferguson & Assoc., Inc., management consulting firm, and president of Robinson, Inc."

William E. Brower, Jr., PhD '69, reports: "I am a professor and chair of the Department of

Mechanical & Industrial Engineering at Marquette University. My department is only the third in the country to obtain a stereo lithography unit able to convert CAD designs to parts in hours. This unit at Marquette is being utilized heavily by Milwaukee-area industry." . . . **Klaus M. Zwilsky**, '54, has received the National Materials Advancement Award of the Federation of Materials Societies. The award "recognizes individuals who have demonstrated their outstanding capabilities in advancing the effective and economic use of materials and the multi-disciplinary field of materials science and engineering generally, and who contribute significantly to the application of the materials profession to national problems and policy." For a decade, Zwilsky has been the staff director of the National Materials Advisory Board, a part of the National Research Council that is the operating arm of the NAS and NAE. . . .

Soumendra Nath Basu, PhD '89, has been named an assistant professor of manufacturing engineering at Boston University's College of Engineering. Prior to the appointment, Basu was serving as a postdoctoral research associate at the Los Alamos National Lab in New Mexico. Basu was a recipient of the National Science Talent Award in India and has published extensively.

James H. Heasley, ScD '64, of Shaker Heights, Ohio, died on November 6, 1990. He died suddenly while attending a conference at Penn State. He served on MIT's faculty as an assistant professor of ceramics from approximately 1962 to 1964. After leaving MIT he ran his own consulting company for a period, then joined Ferro Corp., where he recently served as director of research.

IV ARCHITECTURE

Kurt Eichenberger, MAR '82, reports: "My private practice continues to expand. We recently have been awarded a commission to design a homeless and transitional housing shelter for Wake County and the city of Raleigh, N.C. We have also recently received an award of merit for the Wake County Youth & Health Services Center from the Spectator Triangle Architecture Awards Program. Much of my work continues to be for the social services and local government sector including a contract with N.C. State University to provide miscellaneous architecture services." . . .

Angelo Petrozzelli, MAR '72, works at a firm called Design Partnership Architects, Inc., in Haverhill, Mass. . . . **Kenneth Schwarz**, MAR '66, writes from Mill Valley, Calif.: "I am a managing principal of the San Francisco office of Anshen & Allen Architects. I recently returned from Kiev where I am designing a medical clinic for the child victims of the Chernobyl nuclear disaster. The project is sponsored by Greenpeace and the USSR Academy of Sciences." . . . **Leonard Henry**, MCP '66, who works for the Center for International Media Research in Holland, recently completed a series of television documentaries about national lifestyles in outer republics of the USSR.

Robert S. Allan, MAR '55, sends word from Irving, Tex.: "My oldest son, David Allan, SM '90 (II & XV), graduated from MIT in June in the 'Leaders for Manufacturing' graduate program. Visiting the campus and seeing David go through the same process I did made me realize that MIT was better than ever and truly keeping up with the challenges of the future. My architectural firm is now in the 21st year of practice. Currently we are busy designing a large church which is designed with the flexibility of easy conversion into a theatre for religious plays and musicals. Also I teach part-time at two local universities. I am grateful for all the learning experiences from MIT and other sources for enabling me to have such an exciting and rewarding career. MIT is truly a unique and very outstanding place to attend." . . . **William Demiene**, MAR '57, is working at Albert Kahn Associates, Inc., architects and engineers, where he is VP and a member of the

board of directors. . . . **Andrew Acaya**, MAR '70, writes: "I recently passed the NCARB Architectural Registration Exam and received an architectural registration in New Mexico. I am the first member of my Laguna Pueblo Tribe to be registered and I am believed to be the first Pueblo Native American to be registered in New Mexico. I am also thought to be the first full-blooded Native American to graduate from MIT's Graduate School of Architecture."

Harold MacDonald, MAR '88, writes in from Carlsbad, Calif., that he "drove across the continent in an old, damaged vehicle over the mountains and the high chapparal down and down to the sea. Whereupon he found fragments of abalone shell polished by the gravelly ocean sand. And southward along the coast he came upon a job with Joseph Lancor Architects in San Diego. And he did learn to ride the waves. And he got fired. And found a new job for twice the pay with another architect. And still he finds crystalline moments getting slam dunked by monster waves." . . . **Bamerqui Mario**, '62, sends word from Caracas, Venezuela: "I am designing and planning a new city project in Sahara Maroc. I am also designing and planning a city near the capital in Morocco. It is under construction. I have worked on some touristic projects in Morocco and Venezuela and have designed eight Metro stations in Caracas that are in use."

George H. Sherwood, MAR '32, of Andover, Mass., died on November 25, 1990. Sherwood was a self-employed architect with expertise in historical design. Among the museums he restored are the Old State House in Boston, the 1680 Hoxie House in Sandwich, Wye Plantation in Maryland, and Fort Ticonderoga. He designed many business buildings, including those for Fidelity Fund, Houghton Mifflin, and the red brick Merchants Cooperative Building that faces Boston Common. In addition, Sherwood designed a number of shopping centers and private residences. One of his first projects was to design the mobile housing for the Tennessee Valley Authority when the Atom City was built. After surviving a heart attack in 1972, Sherwood began an antique business with his wife. They exhibited in a number of major shows, such as Boston's Ellis Memorial.

V CHEMISTRY

John Viola, PhD '67, writes from Thousand Oaks, Calif.: "My work at the Rockwell Science Center has expanded to include seeking applications for Rockwell's solid state photomultiplier, a single-photon counting device based on extrinsically doped silicon. Operation at 7-8 degrees Kelvin is required to reduce dark current to an acceptable level. One possible application is as a detector for the superconducting supercollider. There will be others." . . . **Chris Orvig**, PhD '81, reports: "I have recently been tenured and promoted to associate professor in the Department of Chemistry at the University of British Columbia." . . . In June 1990 **Robert B. Frye**, PhD '76, became manager of Noryl Product Technology at GE Plastics in Selkirk, N.Y. . . . **Harold R. Rogers**, PhD '78, sends word: "One of the perks of teaching is having an interesting 'office' for my 3-year-old to visit. Mike helps me fill the NMR, work with the glove box, adjust the AC, etc. Is it too much to hope he'll be cleaning glassware soon?"

William R. Lyman, PhD '47, sends word: "I have been retired from the Rohm & Haas Co. for the past five years. I enjoy a fairly active life with volunteer work, gardening, and travel." . . . **Jim E. Davis**, PhD '60, writes: "I've been at Harvard for about 3½ years as director of biochemistry, after 15 years at the University of Pennsylvania. I teach general chemistry and physical biochemistry and look after the administration of the department. Recently I have been speaking on atmospheric chemistry to Harvard alumni clubs (though I am careful to identify myself as a Tech

alumnus). In October I had the pleasure of meeting Hank McClark, '62, (XII), secretary of his MIT class, at the Birmingham, Alabama, Club. I would be happy to hear from chem graduate alumni or undergrads from '60-'62 whom I may know."

J. Stuart Fordyce, PhD '59, writes: "I received NASA's Medal for Outstanding Leadership in 1990. I also lectured at the International Space University, held at York University in Toronto, during the summer of 1990. I'm looking forward to the 1991 session to be held in Moscow at the Moscow Aviation Institute." . . . **A. Truman Schwartz**, PhD '63, was elected a Fellow of the American Association for the Advancement of Science in 1990. . . . **Maung Maung Sein**, SM '61, writes: "I have been working for the Alfa-Laval Group of Companies since 1964—4 years in Burma, 10 years in Kuala Lumpur, and now 12 years in Singapore. My 10 years in Malaysia were devoted to leading a group of engineers developing rubber latex concentration, crude palm oil purification, clarification, fractionation, and refining, plus tapioca starch processing. Now I am a director and VP in Alfa-Laval Southeast Asia's regional office in Singapore with special duties promoting the company's edible-oil process technologies to all Asian and Pacific-rim countries."

Richard A. Durst, PhD '63, sends word: "After 25 years at the National Bureau of Standards (now the National Institute of Standards & Technology), I have accepted a faculty position at Cornell University. I was appointed professor of chemistry in the Department of Food Science & Technology and director of the Cornell Analytical Chemistry Labs at the New York State Agricultural Experiment Station at the Geneva, N.Y., campus. . . . **Byron G. Hays**, PhD '64, R&D director for special projects of BASF Corp.'s Publication Inks Division has delivered an address at a recent conference of the National Association of Printing Ink Manufacturers. His subject was organic pigment applications in oil- or water-based printing inks. Hays has been involved in scientific advances in fields as varied as synthetic leather and pigments. He has been with BASF and predecessor company, Inmont Corp., for 24 years. . . . **Janice M. Klunder**, PhD '87, is one of three researchers to be granted a patent for Optically Active Derivatives of Glycidol. The patent has been assigned to MIT.

Alexander Pines, PhD '72, professor of chemistry at the University of California at Berkeley, has been named a co-winner of the prestigious Wolf Prize for chemistry in 1991. Pines, who is also a senior scientist at the U.C. Lawrence Berkeley Lab's Materials Sciences Division, will share the \$100,000 award with Richard R. Ernst of Switzerland. Pines is being honored for his research in using nuclear magnetic resonance to reveal the chemical structure of solids, which has applications in plastics, petroleum, and ceramics. . . . **William A. Peters**, PhD '72, has been appointed an associate director of MIT's Energy Lab where he will assist in the identification, planning, administration, and technical management of research programs. In his new role, Peters will be especially concerned with topics on fuels technol-



M.L. Coleman

ogy and associated environmental and health effects, e.g., fuel extraction, purification, upgrading, and utilization, renewables, and human health impacts of combustion emissions. After post-doctoral study at Yale, he returned to MIT in 1974 as a research associate in chemical engineering affiliated with the Energy Lab. Peters became an Energy Lab program manager in 1976 focusing on issues in fuel conversion and the health effects of fossil-fuels combustion.

Marcia L. Coleman, PhD '73, has been promoted to technical director of Du Pont Polymers. She will be responsible for new technology development for the company's polymers business. In this position, Coleman will direct polymers operations at Du Pont's Experimental Station and Chestnut Run labs. Coleman joined Du Pont in 1973 as a research chemist in textile fibers and advanced in a succession of technical and managerial posts. . . . **Robert A. Duce**, PhD '64, has been named chair of the newly formed advisory board of the School of Science and Mathematics at Roger Williams College in Narragansett, R.I. Dean of the Graduate School of Oceanography at the University of Rhode Island, Duce is also vice-provost for Marine Affairs and director of the Center for Atmospheric Chemistry Studies at URI. He taught previously at the University of Texas, the University of Hawaii, and the University of Otago in New Zealand. . . . **Paul F. Hogan**, SM '68, is a new member of the board of directors at Carney Hospital in Boston. Hogan continues as director of management support and development at the Bank of Boston. . . . **Gerald D. Laubach**, PhD '50, has retired as president of Pfizer, Inc., located in New York City.

David V. Collins, PhD '48, of South Hadley, Mass., died on October 28, 1990. Collins was a town official and had retired as a research chemist at James River Graphics Co. in 1985. He had worked previously for Monsanto Corp. A Navy veteran of World War II, he was a lieutenant (j.g.) aboard destroyer escorts in the North Atlantic. Among other community activities, Collins participated as a chorister at his church and served on the town's appeals board. . . . The Alumni/ae Association has been notified that **Mary Elizabeth Irvine**, '34, of Laguna Beach, Calif., died on May 28, 1990. There was no further information provided.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Jerome D. Abernathy, SM '84, writes: "Well, I'm moving on. . . I left Morgan Stanley & Co. in September and I am now VP and manager of the Analytical Trading Group at Merrill Lynch & Co. in New York." . . . **Cornelius N. Weygandt**, SM '33, sends word: "I am still working three days a week for Stone & Webster Engineering Corp. in Cherry Hill, N.J., as an ombudsman." . . . **Robert C. Berwick**, PhD '82, writes in: "I am an MIT professor in EECS and the AI Lab. I have just published *Principle-Based Parsing* (Kluwer Academic Publishers, 1991), and am soon to publish my sixth book *Computational Linguistics* (MIT Press, 1991)." . . . Commander **James R. Seeley**, EE '77, reports: "I was recently reassigned in the Navy to the Space & Naval Warfare Systems Command as the project manager for the development of Navy Command and Control Systems-Afloat."

Eberhard F. Wunderlich, PhD '78, writes: "I am currently a department head at AT&T Bell Labs in Holmdel, N.J., and am responsible for packet data network services planning." . . . **Lynden U. Kibler**, SM '56, reports: "I retired from AT&T last December and am now a consultant to the IEEE on emerging technologies videotapes. I have two grandchildren. I chair the Middletown, N.J., Environmental Commission and I'm a member of Trenton State College's executive committee."

Captain **Steven N. Anastasion**, SM '48, reports that he is VP and secretary for the International Council of Academics of Engineering & Technological Sciences. "I'm also an admirer of the great

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Navy of the state of Nebraska," he says. . . .

Robert E. Rouquette, SM '76, reports: "I married Sharon Rose Turner on April 25, 1987; Robert J. Rouquette was born April 9, 1988; Louise Elaine Rouquette was born February 28, 1990; I ended a private practice in acoustic and electronic engineering last November; and I'm now employed as a senior staff engineer by Digicourse, Inc., in Harahan, La., a manufacturer of military, scientific, and commercial instruments. I'm also employed as a senior engineer by Educational Electronics Corp., also in Harahan, as a sound-system contractor." . . . **Mark R. Tuttle**, PhD '89, reports from Cambridge: "I have been working as a member of the research staff at the DEC Cambridge Research Lab since graduation. I am working on (primarily) theoretical aspects of distributed and parallel computing."

Louis Weinberg, ScD '51, writes: "I attended the General Assembly of the International Union of Radio Science as a U.S. delegate of Commission C. It was held in Prague, Czechoslovakia, last September. I've just suffered mandatory retirement to professor emeritus. I was professor of electrical engineering at City College and a professor of math and computer science at CUNY's Graduate Center. Now perhaps I'll write my book on graph and matrix theory and applications. My son Paul is outdoing his dad as a writer, having a book on Unix, on Xenix, on SQL, in addition to collaborating on a fourth book on how to solve the Rubik's Cube. I keep urging him to get a doctorate at MIT to supplement his Stanford MS." . . . **Charles Campling**, SM '48, reports: "Attended, with my son **Fred M. Campling**, '70, (I), the 20th reunion of his class. At dinner on June 8 at the MIT Museum, I was amazed to find that this interesting museum is located in the former headquarters of General Radio (now GenRad) on Mass. Ave. I graduated with a BA from Queen's University in early June of 1990, the same university from which I obtained a BSc in 1944. The BA is 'with distinction' and my concentration was in French language and literature."

Wilbur B. Davenport, Jr., ScD '50, sends word: "We moved back to the mainland (to Sunriver, Ore.) from Hawaii in June 1987. Since January 1989 we have been splitting our time between Oregon and Hawaii. I go back to teach in the Electrical Engineering Department at the University of Hawaii at Manoa during their spring semester and Joan goes back to the Honolulu Academy of Arts as a docent." . . . **Miles Posen**, SM '84, is employed by Beltone Electronics Corp. in Chicago, Ill., as a manager of advanced manufacturing and systems technology.

William M. Crampton, SM '55, reports: "I am enjoying retirement (from Honeywell) in the rural fruit-growing area of northwestern lower Michigan. Keeping busy adding on to our house and engaging in volunteer community activities, including conservation and environmental activities, a folk music group, and other civic causes. In the winter my wife and I cross-country ski out our back door, and in the summer we swim or sail in Bear Lake out our front door. We are 50 miles from the nearest freeway, and when an airplane does fly over we go outside and look." . . . **C. John Meldon**, ScD '68, sends word from Redcliff, Alberta, Canada: "This past summer I was appointed to the position of chief of the Defence Research Establishment Suffield, Department of the National Defence. This lab conducts research in support of the Canadian forces in the areas of chemical/biological defence and military engineering."

. . . **Edwin Gabriel**, '51, writes in from Ocean Grove, N.J.: "I was awarded a U.S. patent last July, entitled 'Tongs-Like Cargo Hook Device with Automatic Loading & Unloading Capability.' A similar patent was issued in Australia. Australian manufacturers are being contacted, as they have many hoisting equipment firms. Another U.S. patent on cargo hooks is pending."

Eileen J.R. Baird, SM '87, sends word from Edinburgh, Scotland: "Immediately after graduating from MIT in January 1987, I was employed by



L.S. Metzger



R.M. Harris

Digital Techniques, Inc., a small company located in Burlington, Mass. I was responsible for the design, development, and maintenance of interactive video applications in the corporate, retail, and museum environments. Interactive video systems combine video and computer technology to create clear color images, messages, and sound for users through touch-activated intelligent graphics terminals. In particular, I was the lead programmer for 'Play Away, Please,' an award-winning interactive video exhibit commissioned by the U.S. Golf Association for their museum in Far Hills, N.J. After two years, I was promoted to manager of applications, which reflected my increasing responsibilities. In September 1989, I returned to Edinburgh, Scotland, to fulfill my two-year residency requirement for accepting a Fulbright Scholarship. I have started up my own consulting business, Baird Interactive, Ltd., and I continue to work on interactive video and public access applications."

Bruce Montgomery, '56, associate director of MIT's Plasma Fusion Center, has received the DOE Distinguished Associate Award. Montgomery was cited for recognition of his "outstanding contributions to the development of magnets for fusion research" and for his "leading role in the engineering development, design, and fabrication of the Alcator high-field tokamak experiments and the design of the Compact Ignition Tokamak." This award is the highest department award which can be presented to a DOE contractor; this is only the second time that it has been presented. . . . **Louis S. Metzger**, '69, has been promoted to technical director of Strategic Communications within the Center for Air Force C³ Systems at the Mitre Corp. in Bedford, Mass. He has been associate technical director of Tactical Communications since joining the company in 1987. Before joining Mitre, Metzger was an assistant VP at M/A-COM Government Systems, where he managed the firm's Boston Engineering Center. Earlier, he worked at MIT's Lincoln Lab as associate leader of the Satellite Communications System Engineering Group. . . . Also at Mitre, **Richard M. Harris**, '63, has been promoted to VP in the company's Center for Advanced Aviation System Development, located in McLean, Va. Before his new position, Harris was chief engineer in the former Washington C³I Division for the past two years. Prior to that, he served for four years as technical director of the Navy and Information Systems Division.

Carl Barus, SM '48, of Swarthmore, Pa., died on October 29, 1990. Barus was professor emeritus of engineering at Swarthmore College and a political activist. After active duty in the Pacific during World War II as an officer on the battleship *Indiana*, in charge of radar and other electronic equipment, Barus studied at MIT and participated in research at Raytheon Manufacturing Co. related to guided missile development. According to a Swarthmore press release, "He came to feel that his work was not consistent with his social concerns, and began looking for a teaching position at an institution that was not geared toward training and research for military purposes. At his sister's suggestion he decided to teach at Swarthmore, which had an engineering program but because of its Quaker background

was more hospitable, he felt, to peaceful uses of science and technology." Barus joined Swarthmore in 1952 and in 1972 achieved the rank of full professor. He taught electrical engineering subjects with an emphasis on electromagnetics, circuits, and communications. Although he retired in 1985, Barus had continued activity on campus and was still a member of the Swarthmore Faculty Seminar on Central America, which he helped to found after the U.S. invasion of Grenada. He was a member of the American Civil Liberties Union and many similar organizations, and in the 1950s began to support and participate in demonstrations against preparations for nuclear and biological warfare. As a result of experiences he had while a visiting professorship in Africa, Barus became a surrogate father and mentor to African students at Swarthmore. He was also a strong supporter of the college's African-American students and of its Upward Bound enrichment program for minority high school students. He was concerned with the social impact of science and technology, particularly the risk of nuclear power plants and the ensuing relationships between politics, economics, and engineering. Barus published many papers on these subjects, in addition to active participation in several organizations working for change in these areas.

Wilbert P. Frantz, SM '34, of Tamworth, N.H., died on October 22, 1990. He worked as a navigational engineer for Sperry Corp. in Long Island, N.Y., for many years. He was an avid outdoorsman and a member of the Appalachian Mountain Club. . . . **Vincent C. Oxley**, SM '67, of Waltham, Mass., died on September 4, 1990. Oxley was a longtime employee of GTE. From 1984 until his retirement in 1987, he served as the senior program manager for the Advanced Systems Organization of GTE, where he was responsible for acquisition, planning, and direction of major government electronic communication programs. During this period he also served as general manager for power systems at the Waltham Development Center Facility of GTE, where his group was charged with R&D of reliable high-energy battery systems. Oxley was in several positions within GTE including technical director of the Electrical R&D Department, director of engineering, and department manager of the Electronic Systems Lab. Prior to working for GTE, Oxley worked for Bell Aircraft Corp. in Buffalo, N.Y.

The Alumni/ae Association has been notified that **J(ames) Preston Conner**, SM '35, of Campbell, Calif., died on November 11, 1990, and **Sekharipuram N. Seshadri**, SM '63, of Bombay, India, died in February 1986. There was no further information provided.

VI-A INTERNSHIP PROGRAM

The world in contrast. A year ago I wrote we had experienced the coldest December in the records of the Boston Weather Bureau. Now December '90 has just ended as the warmest December in Boston on record (+7° above average)—and without a major snowstorm in the area, as yet. Meanwhile, I hear about all of you experiencing the extreme cold in the midwest, storms and flooding in the Pacific northwest, and freezing temperatures in Dallas. Perhaps New England isn't so bad in comparison after all!

In Dallas, VI-A has lost a longtime supporter. Mr. George L. Berryman of Texas Instruments, Inc., took retirement in December. For the final 16 years of his 31-year career at Texas Instruments, George handled the personnel side of the VI-A Program, just about from the beginning of VI-A's association with TI and during my tenure as director. We'll miss George's helpful expertise in the handling of student assignments and the annual arrangements for Cecil Green's TI VI-A summer dinner meetings at the downtown Petroleum Club. Some of you VI-A TITs may wish to drop him a note (home: 10737 Webster Terrace, Dallas, TX 75229). . . . **Robert H. Kingston**, SM '48, has returned from his fall term stint

at Imperial College of Science, Technology & Medicine in London. While there he met and dined with **Joseph R. Babiec, Jr.**, '90, who is at the London School of Economics on a Marshall Scholarship. Joe called us while home for the Christmas holidays.

Several cases of "satellite piracy" have made the news lately. A 1987 case involved injecting a religious message into the Playboy Channel. And there was the famous "Captain Midnight" case in 1986 where a protest against scramblers was injected into the HBO pay-television channel.

Michael J. Marcus, ScD '72, of the FCC headed the technical investigation of these cases which led to a conviction in September 1990. . . . The first of November we had a visit from **Edward C. Giaimo**, SM '75, of Bellevue, Wash., east on some consulting business for his new firm Clearsoft, Inc. Ed was formerly a VP at Zetron, Inc., in Bellevue. . . . Another visitor was **Imre Gaal, Jr.**, SM '86. Imre will complete his work on an MD at Dartmouth College this coming June and plans to go into medical research. We had a long and pleasant chat.

By happenstance one evening, while shopping in a Natick, Mass., mall, I ran into **Krishna N. Mahabir**, SM '89. Krish is living at home in Medfield, Mass., and working at Fidelity Investments in Boston. We had a long chat about his career change following his graduate study in EECS at MIT. . . . Stopping by, over the holidays, was **Denice D. Denton**, PhD '87, on the faculty of the Department of Electrical & Computer Engineering at the University of Wisconsin in Madison. . . . East on business, in November, was **Steven Weiss**, SM '82, who paid us a visit. Steve is director of Marketing Programs for Neuron Data of Palo Alto, Calif.

Others who've visited the VI-A Office include: **Jeffrey P. Applebaum**, SM '90, of Sunnyvale, Calif.; **Karl M.J. Lofgren**, SM '77, of Newport Beach, Calif., here for the Microelectronics Research Review Conference, who told us he and Christine now have two daughters; **Earl C-H Yen**, '88, who writes he has just joined Hancock Venture Partners, a Boston-based venture capital firm focusing on high-tech venture investments; and **Kenneth A. Zeger**, SM '84, who is on the EE faculty at the University of Hawaii in Honolulu.

My Christmas was, again, made most pleasant by the holiday cards I received. Those connected with VI-A came from the following (alphabetical): . . . **George L. Berryman** & wife JoAnn; **Geoffrey J. Bunza**, PhD '81, & family; **David V. Burke**, PhD '72 (XIII), of Draper Lab.; **John D. Chisholm**, SM '76; **John F. Cooper**, SM '76, & wife Melissa; **Michael D. Ernst**, '89; **Stephen M. Foster**, SM '90; **Mark T. Fuccio**, '80, & wife Jacqueline; **Edward C. Giaimo**, SM '75; **Cecil H. Green**, '23; **Bradford E. Hampson**, SM '77, & wife Odette; **David L. Lyon**, PhD '72, of Pacific Communication Sciences, Inc., in San Diego; **Dorran L. Morrison** & wife Nadine, retired VI-A coordinator for the G.E. Co. in Pittsfield, Mass.; **Paul E. Stoft**, ScD '55, retired VI-A coordinator at Hewlett Packard in Palo Alto, Calif., & his wife; **Vincent H. Tobkin**, SM '73, & family in San Francisco; **John A. Van Raalte**, PhD '64, & wife Andrée of Lancaster, Pa.; and **Bruce D. Wedlock**, ScD '62, director of MIT's Lowell Institute School. Thanks to you all.

I am also proud to announce that I have been selected to appear in *Who's Who in American Education*, 1992-93, due out next fall; this in addition to being included in Marquis' *Who's Who in the East*, 1991/1992, published this past fall. . . . One last note for all to ponder. 1992 will witness the 75th anniversary of the establishment of the VI-A Program. The first students were enrolled in 1917 from the Class of '19. I, and the Department, welcome any suggestions for an appropriate celebration. It'll be interesting to see what MIT's Chemical Engineering Department does, this year, to celebrate their Course X-A's (Chemical Engineering Practice School) 75th anniversary. Please communicate your own ideas to me at the VI-A office, here at MIT.—John A. Tucker, Direc-

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VII BIOLOGY

Tse-Wei Wang, PhD '77, writes: "I was recently tenured at the University of Tennessee in the Department of Chemical Engineering, and promoted to an associate professorship. . . .

Stephen D. McCormick, PhD '83, is a fish biologist for Northeast Anadromous Fish Research Lab in Turners Falls, Mass. . . . **Robert A. Weinberg**,

'64, Course VII professor, is this year's recipient of the Samuel Roberts Noble Foundation Research Recognition Award. . . . MIT Professor Emeritus **Herman Eisen** and Professor **Susumu Tonegawa** were among the inventors of a new eighth T cell antigen receptor patent owned by MIT and exclusively licensed by T Cell Sciences, a Cambridge-based company. The patent covers the combined alpha and beta subunit proteins. According to a company press release it is "important in establishing a proprietary market position" for the therapeutic products they are developing to treat autoimmune diseases.

The Alumni/ae Association has been notified that **Muriel Bliss Wilbur**, MPH '33, of Arlington, Mass., died in 1987, and **Solomon S. Lifson**, MPH '43, of the Bronx, N.Y., died on May 31, 1989. There was no further information provided.

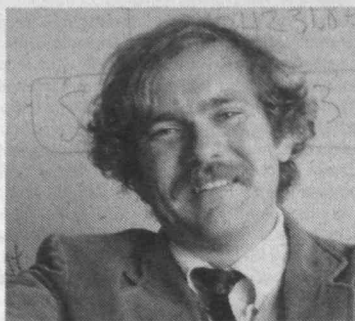
VIII PHYSICS

Nai-Chang Yeh, PhD '88, sends word from Pasadena, Calif.: "I was appointed an assistant professor of physics at Caltech in August of 1989. My research area is in condensed matter experimental physics. My current research focuses on the physical properties of high-temperature superconductors. I have been awarded the Alfred P. Sloan Fellowship this year." . . . **Stephen A. Wood**, PhD '83, writes: "I have recently taken the position of staff scientist at CEBAF (Continuous Electron Beam Accelerator Facility), a 4 GeV accelerator being built in Newport News, Va. I have not previously reported that I am married to Eileen Chadis Wood and that I have a two-year-old son, Ronin." . . . **Peter B. Ulrich**, PhD '66,

reports: "After nine years in private industry, I am returning to government service as the program manager of NASA's Space IR Telescope Facility (SIRTF). This is the fourth of the 'Great Observatories,' the others being the Hubble Space Telescope, the Gamma Ray Observatory, and the Advanced X-ray Astrophysics facility. SIRTF is a seven-year program due to be launched in 1999."

Margaret Weiler, PhD '77, writes from Belmont, Mass.: "I joined Honeywell's Electro-Optics Division (now Loral Infrared Imaging Systems) in 1988. Working on development of radiation-hard HgCdTe photovoltaic detectors for both military and space applications." . . . **Randall Tagg**, PhD '87, writes: "I recently joined the faculty of the University of Colorado at Denver as an assistant professor of physics. I'm doing research in chaos and fluid dynamics." . . . **Robert D. Kaplan**, SM '86, reports: "I was recently married to Judy Kravitz, who is owner of Cezanne Desserts, the best bakery in Cambridge, just a five-minute walk from MIT. Also, I was recently promoted to senior acquisitions editor (physics) at Academic Press." . . . **James F. DeBroux**, SM '79, sends word: "I recently moved from Germany to Fort Leavenworth, Kans., I was promoted to lieutenant colonel and assigned to the U.S. Army Combined Arms Command—Combat Developments. I will serve as the chief of the Technology Division in the Force Requirements Directorate. My son, Daniel, started last summer at West Point as part of the USMA class of '94."

Ronald C. Davidson, Course VIII professor and associate director of the Plasma Fusion Center, has left MIT to become director of the Princeton



J.A. Jackson

Plasma Physics Lab. Davidson assumed his new position last November. He had been professor of physics at MIT since 1978 and directed MIT's Plasma Fusion Center from 1978 through 1988, when Ronald R. Parker, ScD '67 (VI), became the PFC's director and Davidson became associate director. Before joining MIT, Davidson worked for two years at DOE's Office of Fusion Energy, where he served as director of the Applied Plasma Physics Division. While at MIT he was the first chair of the DOE's Magnetic Fusion Advisory Committee from 1982 to 1986. Although Davidson's departure is viewed as a huge loss for MIT, his relocation is considered a great gain for Princeton, which is in transition between completing its major experiment, TFTR, and an as yet unapproved burning plasma experiment. . . . **Albert Wheelon**, PhD '52, former chair of the board and CEO of Hughes Aircraft Co., has been elected to the Aerospace Corp.'s board of trustees.

James A. Jackson, PhD '86, has been named an assistant professor of astronomy at Boston University's College of Liberal Arts. Jackson, who specializes in the study of galaxies and star formation, joined the university from the Max-Planck-Institut für Physik und Astrophysik in Munich, where he worked as a postdoctoral research physicist since 1988. Prior to this, he served as a visiting research astronomer at the Observatoire de Paris-Meudon and as a postdoctoral research scientist at the radio astronomy lab at the University of California at Berkeley. . . .

Mark Halpern, '76, has published *Binding Time: 6 Studies in Programming Technology & Milieu* (Ablex, 1990). It is a collection of related but independent essays on the relationship within the computing world between intellectual constructs—thought-experiments, theories, theorems, proofs—and observable facts.

X CHEMICAL ENGINEERING

Marc Machbitz, SM '78, writes: "My wife Lori and I are parents for the first time. Rachel is 6 months old. I'm now senior human resources representative at Chevron Research & Technology Co. in Richmond, Calif." . . . **Gabriel F. Avgerinos**, SM '75, reports: "I have expanded the energy consulting activities of Poten & Partners, Inc., to a group of 24 professionals worldwide. I was made a partner two years ago and am currently director of energy & shipping consulting. Activities include: LPG, LNG, condensates, petroleum products (i.e., naphtha, fuel oil, asphalt), and their shipping transportation." . . . **Arthur E. Higinbotham**, SM '60, is a group VP for the Tape Group at the 3M Co. in St. Paul, Minn. . . .

Shantaram G. Kane, ScD '71, reports: "I am the R&D manager with National Organic Chemical Industries, Ltd., in India. The company R&D is in petrochemicals and agrochemicals for day-to-day support, process/product development, and discovery of new molecules as agrochemicals of the futures." . . . **Steven R. Izatt**, SM '84, sends word from Philadelphia, Pa.: "I am currently serving as president and CEO of IBC Advanced Technologies, Inc., a high-tech separations science company. My daughter, Christina Satu Izatt, was

born on March 30, 1990." . . . **George T. Keene**, SM '52, writes: "I retired from the Federal Systems Division at Eastman Kodak Co. on July 1, 1989, after 37 years. I studied to be and am now a licensed general contractor for the state of California. Nicki and I are rebuilding homes in the Pasadena area. Finished one, sold it, and now we are working on two and building one new log home (two hours from L.A.) for rental near Tehachapi. On January 1, 1990 I started full-time with Optical Corp. of America's Applied Optics Division in Garden Grove, Calif. It is very exciting to be with a small (250 people) outfit that really moves! We build space and aircraft optical systems using glass, beryllium, and IR refracting materials (ZnSe, Ge, etc.). I serve as senior program manager at OCA-AO." . . . **Tae-Sup Lee**, ScD '66, reports: "My political career in Seoul, Korea has been: minister of state for political affairs from 1983-84, minister of science & technology from 1987-88, and a three-term member of parliament from 1978 to the present. My industry career has included being a president of Daewoo Engineering Co., Korea Steel & Chemical Co., and Pungnam Textiles Co., from 1972-78. I was also a senior researcher at Shell Oil in the USA from 1966-72. I am a two-term president of MIT's Club of Korea from 1989 to the present, and my son, Boong-Kyu, is currently in the PhD program at the Sloan School of Management (We are the first Korean father-son alumni)."

E. Morse Blue, SM '37, sends word: "After 40 years with Chevron Research, and 30 years on the chemical engineering faculty at the University of California at Berkeley, I am starting to retire, although I'm still involved in consulting. I received two awards this year: AIChE's Professional Progress Award and the University of California's Alumni Citation for service to the university." . . . **David E. Reid, Jr.**, SM '38, writes: "At '70 I taught thermodynamics at the University of Jacksonville, mostly to Navy submarine people (Florida Institute of Technology had a branch at Jacksonville). I'm pleased to report I can still do thermodynamics." . . . **Herbert L. Stone**, ScD '53, reports: "I retired from Exxon in October 1988, and formed Stone Engineering in 1989, under contract to B.P. Exploration, Inc., and others. My paper was accepted by the Society of Petroleum Engineers for their February 1991 symposium on reservoir simulation. I'll offer a second paper at the annual SPE meeting this fall in Dallas. And I have two other papers in preparation. There is life after retirement!" . . . **David Brown**, SM '40, reports from Key Largo, Fla., that he is still retired and interested in finance, friends, and music.

Sang-Chun Rah, ScD '84, reports: "I am working as general manager of the Petroleum Products Lab at Ulsan Research Center of Yukong Limited. Yukong is the largest oil company in Korea." . . .

David B. Escarraz, CHE '83, sends word: "I am a systems engineer in R&D for a company named Market Knowledge, Inc., located in my native Chicago. One of my recent projects was to edit and assemble *The 1991 USSR Business Guide & Directory*, an 800-page directory published by my firm in cooperation with the Soviet government. It lists over 2,000 private commercial Soviet firms in all regions of the Soviet Union." . . . **Albert Sacco, Jr.**, PhD '77, writes: "I was appointed head of the Chemical Engineering Department at Worcester Polytechnic Institute in July, 1989. In August, 1990, I was selected by NASA as one of two finalist candidates to fly my experiment on zeolite crystal growth on STS-50 space shuttle as a payload specialist for the March 1992 flight." . . . **Larry R. Sewell**, CHE '72, reports: "I moved to Houston, Tex., after 10 years in Niagara Falls, N.Y., with Oxychem. Now I am a business manager at Olefins. I am married and have two daughters, Lauren (12) and Erica (9)."

Kevin Olmstead, CHE '83, completed his PhD in environmental engineering at the University of Michigan in April 1989. He has continued to work there as a research associate and a lecturer. . . . **Graham A. Woerner**, SM '76, writes: "I have recently invented Isocore, a coaxial cable for

microwave telecommunications. The coax has solved the temperature-related problems of conventional microwave coax. I have purchased and installed a production line. **Al Horn**, PhD '84, is a co-inventor." . . . **Edgar B. Gutoff**, ScD '54, is consulting in the area of coating. He has co-authored a book, *The Application of Statistical Process Control to Roll Products*. . . . **William K. Fraizer**, SM '80, writes: "I am now manager of Environment, Safety, & Health for Chevron Nigini Pty. Ltd., located in Port Moresby, Papua New Guinea." . . . **Howard S. Bryant**, ScD '56, reports: "I have been elected to the executive board of the Engineering Construction Contracting Division of the American Institute of Chemical Engineers. This organization represents the process plant design and construction industry in the U.S. I am corporate VP for engineering at the Witco Corp. in Woodcliff Lake, N.J."

Glen H. Ko, PhD '88, has become manager of Polymer Applications at Aspen Technology Corp. in Cambridge. . . . **Jonathan G. Harris**, a chemical engineer whose research involves the development and application of molecular modeling and simulation techniques, has been appointed to the MIT Department of Chemical Engineering as the Herman P. Meissner, '29, Career Development Assistant Professor. The chair honors the late Professor Meissner, who died October 24 at the age of 83. An authority on industrial chemistry and thermodynamics, Meissner was a member of the MIT faculty from 1934 until his death. Harris has spent the last two years as a postdoctoral member of the technical staff at AT&T Bell Labs Department of Chemical Physics. In his research, Harris applies molecular modeling and simulation techniques in many areas, including biological membranes, molecular fluids, liquid crystals, colloids, and polymers. He is also involved in the prediction of thermodynamic, mechanical, and transport properties and with the phase equilibria and the kinetics of phase transitions and phase separation.

Elisabeth M. Drake, '58, has been appointed an associate director of MIT's Energy Lab. Drake will give particular attention to topics involving new energy technology and conservation, e.g., global climate change influences on future energy technology, safety and waste management in the nuclear and chemical industries, and energy end-use management. Just prior to her appointment, Drake had been named a recipient of the 1990 T.J. Hamilton Memorial Award given by the American Institute of Chemical Engineers. She was commended for her involvement in the institute's government activities. An AIChE director, Drake has been active in the AIChE locally and nationally. She is a member of MIT's Government Programs Steering Committee and is involved in two sponsored research programs, the Center for Chemical Process Safety and the Center for Waste Reduction Technologies. Before becoming a consultant specializing in the assessment and management of environmental, health, and safety risks associated with the production, transport, storage, and disposal of hazardous chemicals, she was a VP of Arthur D. Little, Inc., in Cambridge, where she had been a member of their technical staff for over 25 years. . . . The AIChE has awarded a 1990 Founders Award for outstanding contributions to the field of engineering to **James Wei**, ScD '55, the Warren K. Lewis Professor at MIT. The organization also awarded a Professional Progress Award to **Robert S. Langer**, ScD '74, Germeshausen Professor of Chemical and Biochemical Engineering at MIT. Langer recently coedited *Biodegradable Polymers as Drug Delivery Systems* (Marcel Dekker, 1990). . . . **Alfred E. Wechsler**, '55, senior VP and chief professional officer at the Cambridge-based Arthur D. Little, Inc., and **Alexis T. Bell**, '46, chair of the Department of Engineering at the University of California at Berkeley, have been elected directors of the AIChE. Wechsler and Bell are two of four new members of the governing council of the 50,000-member society. They will each serve three-year terms. . . . **C. Judson King**, ScD '60, provost of Professional Schools and Colleges and

chemical engineering professor at the University of California at Berkeley, has been named the recipient of the 1990 Warren K. Lewis Award for Contributions to Chemical Engineering Education given by the AIChE. An expert in separation process technology, including drying, extraction and adsorption, King is cited for "his distinguished contributions to chemical engineering education through his scholarship, teaching, academic administration, and service to professional societies and governmental agencies."

The American Philosophical Society has presented the Benjamin Franklin Medal, the Society's most prestigious award, to **Crawford H. Greenewalt**, '22, honorary chair of the board of DuPont. Among other things, Greenewalt was cited for "significant contributions to high-pressure synthesis of ammonia, and to the miracles of technology which brought nylon to the market; and of wide-ranging scientific accomplishments, in particular his study of the flight and habits of hummingbirds; and especially for his vital role in the development of nuclear energy." . . . **W. Mark Saltzman**, PhD '87, assistant professor of chemical engineering at the Johns Hopkins School of Engineering, has been awarded a \$50,000 Camille and Henry Dreyfus Teacher-Scholar Award for 1990 by the Dreyfus Foundation. Saltzman, a specialist in polymer science and engineering, was one of 12 young faculty members at U.S. institutions to receive unrestricted grants for the support of their professional activities. Saltzman's research centers on cell-polymer interactions and the use of polymers for the controlled release of bioactive compounds for drug delivery. His research shows promise of more efficient methods of drug delivery in applications as varied as new contraceptives and improved therapy for brain disease.

Michel L. Besson, SM '60, has been appointed chair of the board, president, and CEO of Norton Co., in Worcester, Mass. Since 1980, Besson has served as vice chair, president, and CEO of CertainTeed Corp., a Valley Forge, Pa.-based company. According to a company press release, "Norton Co. is the world's largest manufacturer of abrasives and a leading producer of engineering materials, including advanced ceramics, performance plastics, and chemical process products."

Major General **Marshall Stubbs**, SM '39, of Raleigh, N.C., died on November 20, 1990. He served in the 8th and 9th Air Force Service Command, European Theater, in WWII. Stubbs was chief of the Chemical Corps in the U.S. Army from 1958-63. He retired in 1963 and lived in Arlington, Va., until 1988. Among the awards and decorations he held were: Distinguished Service Medal, Legion of Merit, Bronze Star Medal, Army Commendation ribbon with oak leaf cluster (U.S.), Ordre de Leopold with palm (Belgium), and Croix de Guerre with palm (France). . . .

William Engs, SM '27, retired VP of the Stauffer Chemical Co., died on February 25, 1990. Until 1954 he was employed as a chemical engineer at American Cyanamid Co., then served at Stauffer until his retirement in 1963. In retirement he was a consultant for Occidental Petroleum Co., and also served with the International Executive Service Corps in Libya and Peru. . . . The Alumni/ae Association has been notified that **Roger S. Holcomb**, SM '47, of Hendersonville, N.C., died in July of 1990, and that **Eli Perry**, SM '47, of Clayton, Mo., died on October 21, 1989. There was no further information provided.

XI URBAN STUDIES AND PLANNING

Enrique Vial, MCP '90, writes: "Since July I have been working with the National Capital Planning Commission in Washington, D.C., as a computer systems developer. This agency's mandate is the protection of the federal interests in the capital region. Here I am in charge of proposing and carrying out a plan for improving the manner in which planners currently use computer technology

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III, S.M. '66
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Dean G. Bostock
Eugene A. Feher
Beverly A. Hjorth
Craig K. Leon
Darlene Vanstone
Brian Michaelis
Daniel Bourque

Technical Specialist
Russel Weinzimmer

Of Counsel
Alfred R. Johnson, '35
Joseph Zallen, '39

gy. For this purpose, I have been working on a user-needs assessment study, while simultaneously becoming involved with ongoing projects to detect their potential for automation. My overall plan will consider the use of the latest computer technology available in land-use planning. Connected with this assignment, I also serve as liaison with professor Joe Ferreira, '67 (VI), and the Computer Resource Lab of the Department of Urban Studies at MIT, for technological transfer between both institutions as they implement a futuristic project called 'Initiative 2050.' This project envisions an innovative planning style for the next 60 years for the capital region, including the development at MIT of customized computer applications, some taking advantage of advanced mathematical/analytical models. My appointment is for a year and a half, after which I plan to return to my country (Chile)."

Thomas J. Nally, MCP '77, reports: "Sorry that I'm a little late in responding, but I have been very busy in the position that I have occupied for the last year as planning director for the Artery Business Committee in Boston. ABC is a non-profit organization founded by downtown businesses dedicated to assuring that the Central Artery/Third Harbor Tunnel is built, and is built in a way that will continue to support business activity in downtown Boston. My business (business?) in the last few months has been centered on helping to move the project toward resolution of outstanding environmental issues. Much progress has been made but several issues remain open. So back to work!" . . . **Richard S. Howe**, SM '61, reports: "I am a professor of engineering and the director of Alliance for Education at the University of Texas at San Antonio. The Alliance focuses on grades K-14 to increase the number of minority women and men pursuing engineering, science, and technology careers. The alliance is involved in numerous activities throughout south Texas."

Shampa Chanda, MCP '89, is currently working for the New York City Department of City Planning for the borough of Queens as a city planner. . . . **Gene B. Milgram**, MCP '75, writes: "In February 1990 I became the chair of the Washington Park Neighborhood Association in downtown Albany, N.Y. Also, work always continues on my contemporary-style conversion of an industrial building into my home, now shared with my new four-month-old, 50-pounds-plus Great Pyrenees puppy (who is expected to grow to over 100 pounds!). I would love to hear from old friends." . . . **Irwin J. Kugelman**, ScD '63, was elected to the National Civil Engineering Department Heads Council of the ASCE. . . . **Jim Hexter**, MCP '86, has been hired by the Providence, R.I.-based SWAP (Stop Wasting Abandoned Property) to run the nonprofit affordable housing group. Hexter was the director of the Wellspring Community Land Trust, a nonprofit housing development group in Gloucester, Mass., before beginning his new job.

Jean A. Riesman, MCP '90, former editor of the East Boston Community News and current MIT graduate student, was recently awarded an honorable mention for a paper on urban planning. Riesman picked up the prize given by the Association of Collegiate Schools of Planning for a paper entitled "East Boston Is Not An Airport." The committee that awarded Riesman's work made the selection on the basis of its originality and high quality. . . . **Tridib Banerjee**, PhD '71, and **Michael Southworth**, PhD '70, are coeditors of *City Sense and City Design: Writings and Projects of Kevin Lynch*, (MIT Press, 1990). Lynch received a BCP in 1947 from MIT.

XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Marjorie Fuller, '32, sends word: "As I am retired, I substitute, as needed, delivering Meals-on-Wheels to one of Wellesley's three routes. Each Saturday I can be seen with a handful of other

'peaceniks' vigilling from 12 noon to 1 in Wellesley Square near the flagpole. I worked on class notes in the *Review* from 1934-39." . . . Navy Lieutenant **Deborah K. Barber**, SM '89, has been promoted to her present rank while serving at the Naval Western Oceanography Center in Pearl Harbor, Hawaii.

Leigh H. Royden, PhD '82, Course XII associate professor of geology and geophysics, has received the Young Scientist Award from the Geological Society of America. The Young Scientist Award, established in 1988, is awarded to a young scientist (35 or younger) in recognition of outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award consists of a gold medal called the Donath Medal and a cash prize of \$10,000. Her citation reads: "Royden, better known as Wiki, has demonstrated her talent for constructing new and extraordinarily coherent physical models of complex geological processes in her work on the Pannonian Basin, Apennines, Hellenides, Tibetan Plateau, and Basin and Range. She has formulated and advanced numerous new concepts, such as proposing that the upper crust is decoupled from the lower crust in basin extension, that retrograde motion of subducted slabs controls the style of mountain building, and that metamorphic data can be directly inverted for the thermal evolution of orogens. Her work has and will continue to provide direction for tectonic geology."

XIII OCEAN ENGINEERING

From Riggs Marine Appraisals, Ltd., in Annapolis, Md., **William C. Gibson**, NA '51, reports: "1990 has been a slow year for marine surveyors (yacht brokers too)." . . . **Christoph Goltner**, PhD '89, writes: "Right after receiving my PhD I returned to Germany. I'm at Daimler Benz in Stuttgart and at first went through a 9-month-long trainee program. Since April 1990 I've been working in the Corporate Strategic Planning Department, focusing on new activities in the field of mobile communications." . . . **Thomas R. Robinson**, OCE '82, sends word from Norfolk, Va.: "I retired from the U.S. Navy in July 1988, the same month we were blessed with the birth of our first son, Reeder. I am now in my second year of fellowship with Old Dominion University, teaching and pursuing a PhD in engineering management." . . . **James F. O'Sullivan, Jr.**, OCE '73, is a partner and general manager of Seaflo Systems, Inc., a subsea engineering firm specializing in deepwater and offshore oil and gas production technology. . . . **Gary R. Laughlin**, SM '70, writes: "On October 22, 1990 I left Kettenburg Marine Corp., where I was the manager for ship repair. I am now working for Temple, Barker & Sloane, Inc., in San Diego as a consultant specializing in ship building, ship repair, and shipyard management."

Kevin Carpentier, SM '82, resigned from the U.S. Coast Guard in October 1989. Now he is employed as a design and development engineer at Raytheon's Submarine Signal Division in Portsmouth, R.I. . . . **Mehmet A. Mesta**, SM '83, sends word from Cambridge that he is involved in international engineering and heavy construction contracts with emphasis upon the marine engineering and the systems management aspects. . . . From Fairfax Station, Va., **Robert W. Henry**, SM '74, reports that he is an executive officer in the U.S. Coast Guard's Marine Safety Center. . . . **Charles E. Mathieu**, NE '60, writes: "At the end of 1990 I retired from my position as the American Professor at the World Maritime University in Malmö Sweden. As one of the founders of this international master's degree institution, I developed programs for our opening in July 1983. We have now graduated seven classes which include students from 105 countries. This has been a marvelously broadening and interesting experience which leaves me with friends

and contacts worldwide." . . . **Kevin J. Fox**, SM '83, reports: "I am currently employed as chief engineer of Long Island Lighting Co.'s Northport Generating Station. One of our projects is working in conjunction with the Electric Power Research Institute (EPRI) to fabricate and install the first header-type feedwater heater in the U.S."

Michael J. Briggs, OCE '81, reports: "I was installed as president of the 700-member Mississippi section of the American Society of Civil Engineers during their fall section meeting last October. I am a research hydraulic engineer in the Coastal Engineering Research Center at the U.S. Army Engineer Waterways Experiment Station in Vicksburg, Miss. I direct research on simulation of shallow water waves with a \$1M wavemaker that can recreate real ocean waves in laboratory basins. I reside in Vicksburg with my wife Mary Ann." . . . **Stephan Barnes**, '74, a naval architect and project manager with Washburn and Doughty, East Boothbay, Me., shipbuilders, has been named the director of The Rockport Apprenticeship, a boatbuilding school. Barnes and his wife Jurate have been living in Maine since 1978, supporting themselves initially by digging clams. Since that time, Barnes has worked on and repaired fishing vessels, built houses, built his own boatbuilding and repair shop, and worked at his profession as a naval architect. . . . Navy Lieutenant **John L. Braun**, SM '87, has recently reported for duty at the U.S. Naval Academy in Annapolis, Md.

XIV ECONOMICS

Arthur G. Ashbrook, Jr., PhD '47, reports: "I am in semi-retired gear, working on a project to standardize global GNP/GDP estimates. My wife, Sassy, and I have lived 26 years in the shadow of Washington's National Cathedral." . . . **George C. Galster**, PhD '74, was appointed to the consumer advisory council of the board of governors at the Federal Reserve System for 1990-92. . . . **Dennis W. Carlton**, PhD '75, of the University of Chicago, and **Jeffrey M. Perloff**, PhD '76, of the University of California at Berkeley, have published a textbook, *Modern Industrial Organization* (Harper Collins).

Kenneth Thomas Rosen, PhD '74, has joined the Stockton, Calif., Grupe Co. as a member of its advisory board. He continues as a professor of business administration and chair of the Center for Real Estate/Urban Economics at the University of California at Berkeley. . . . **David McClain**, PhD '74, has left his position as associate professor and director of the Japan Program at Boston University and accepted an endowed chair position at the University of Hawaii in Honolulu as the Henry A. Walker Distinguished Professor of Business Enterprise. He is also professor of financial economics and institutions there. . . . **Jeffrey A. Miron**, PhD '84, has been named a professor of economics at Boston University's College of Liberal Arts. Miron, whose specialties include Federal Reserve policy and seasonal cycles, was a visiting scholar at Boston University in 1989. He has also been on the faculty at the University of Michigan, where he taught from 1983-89, and at MIT's Sloan School of Management.

XV MANAGEMENT

Elizabeth A. Carter, SM '85, writes: "I am transferring to Hong Kong for one to two years with Mast Industries to be a divisional merchandising manager, working with factories to make clothing for its parent company, Limited, Inc. My husband, **Greg Carter**, SM '85, is accompanying me as a 'trailing spouse,' and he hopes to find excitement, adventure, tennis partners, perhaps even another job!" . . . **Cynthia A. Redel**, SM '84, reports: "I recently left Temple, Barker & Sloane with **Jane Levine**, SM '81, and Steve Levine to

found Information and Technology Strategies, Inc., an information technology consulting firm."

... **Nina P. McIntyre**, SM '84, sends word: "I am now working four days a week in the R&D group at Lotus Development Corp. We have a wonderful 2-year-old daughter named Ellie." ... **Howard M. Bronstone**, SM '90, reports that he is employed by the Ford Motor Co. and assigned to Taurus/Sable business planning. His activities include looking for a house to buy and involvement in the Big Brothers/Sisters of greater Detroit. He notes that on November 1, it was warmer in Detroit at 75° than in Los Angeles, San Francisco, or San Diego. ... **Michael G. McGuire**, SM '73, is a senior VP for marketing & sales at Antenna Specialists of Solon, Ohio, a division of The Allen Group. ... **Larry Jones**, SM '86, writes: "After completing my 'sentence' in Dayton, Ohio, I have recently moved to Stamford, Conn., with Mead as their New England territory manager for forms sales. I am still single, and using that free time to pursue interests in community theater ('Fiddler' in March) and playing bridge, where I am working on becoming a life master. Would love to hear from any classmates in the area."

From Acton, Mass., **Eleanor Phillips**, SM '77, sends word that she is a manufacturing manager on the project team developing and introducing Digital Equipment Corp.'s new Unix-based system. ... **Jamie Blond**, SM '86, is currently working in institutional equity sales for UBS Securities in New York City. He is responsible for the Boston area and he has some New York accounts. ... Since November 1990, **Nobuyuki Murata**, SM '87, has been an assistant VP in the Industrial Bank of Japan's Real Estate & Project Finance Department. From June 1987 to October 1990 he was an assistant manager in the bank's Investment Banking Department.

Enrique Casanueva, SM '89, reports: "After one and a half years in New York, working in the Investment Banking Division of Goldman, Sachs & Co., I moved to London last December, where I continue to work for Goldman Sachs focusing on business opportunities in Spain." ... **Ruth L. Bardenstein**, SM '82, sends word from Ann Arbor, Mich.: "I am currently working for TASC doing operations research and systems analysis for automotive industry applications. I'm married with a 15-month-old daughter, Emily Rebecca."

... **Jorge Peschiera**, SM '75, writes: "I have been senior VP and manager of the Merchant Banking Division at Atlantic Security Bank since 1989. We are active in trading Latin American debt and debt conversions. I manage the bank's own portfolio as well as clients' resources through the Atlantic Latin Fund which invests in Latin debt instruments." ... **Beth Krasna**, SM '83, reports from Thailand: "I have started my own company, Krasna & Associates Co., Ltd., offering international services between Thailand and Europe and Thailand and the United States in the areas of M&A, venture capital, technology transfer, licensing, and joint-ventures. I have recently met classmate **Wang Hon Chan**, SM '83, who is now managing director of the Cycle & Carriage Group in Singapore."

... **Thomas A. Gardner, Jr.**, SM '88, was recently promoted to the rank of commander. He is currently assigned to the under secretary of the Navy as an administrative aide and is working primarily as an analyst of defense budget matters. ... **Howard P. Sharp**, '34, reports that he is retired and has a winter address on Amelia Island Plantation in Florida. ... **Sue Bailey**, SM '87, and **Mitch Hardy** announce the birth of their son Douglas on August 31, 1990. Sue is treasurer of the Northeast Mass. Regional Recycling Committee which helps the 14 member communities set up local recycling centers. ... **Elizabeth Coley**, SM '87, reports: "I am still at UCSD Medical Center. I am becoming very involved in the current movement in health-care systems to adopt and adapt the notion of total quality management. We are developing our own version of a continuous improvement plan: our quality management process. It is interesting and challenging to be in the midst of a dramatic

cultural change effort, and I wish we had more cultural change theory in O.B.I." ... **Tim Connors**, SM '87, reports: "I have just accepted a position as an engineering supervisor at Rosemount, Inc., in Minneapolis. Rosemount is a division of Emerson Electric. My wife, Sarah, and I had been working at Kohler Co. since graduation in 1987. Sarah is now looking for a job in the Minneapolis/St. Paul area."

Lance Roulic, SM '88, writes in from Medford, Mass., that he is in international business development at the Polaroid Corp., where he is responsible for financial activities in the USSR, China, and India. ... **Jeff R. Hotchkiss**, SM '71, has been appointed VP and general manager at Teradyne EDA. ... **John J. Nicols**, SM '90, writes in from Baton Rouge, La.: "We welcomed the addition of Matthew Thomas to the family on July 9, 1990. I am a newly assigned senior product supervisor in the Flame Retardant Chemicals Group at Ethyl Corp." ... **Paul R. Jandreau-Smith**, SM '86, has been promoted to manager of new business development at Wunderman Worldwide, Young & Rubicam's direct marketing agency. ... **Jay Massimo**, SM '87, reports: "I continue to be an assistant VP for high technology lending at Bank of Boston Corp. in Boston. I have been active in recruiting at the Sloan School and gave a presentation on behalf of the Bank last November. My daughter, Diana Andrea, recently completed 16 months! She was born July 19, 1989. My wife and I are quite proud!" ... **Allen C. Barbieri**, SM '87, sends word: "I am the CFO at First Federal Bank in Salt Lake City. Skiing, fishing, hiking, skiing, skiing, sometimes working. Being a dad and loving it!" ... **Bruce McBratney**, SM '89, writes: "I am still at Boston Consulting Group, Inc. Julie and I really enjoy Chicago and our 7-month-old baby boy named Ben."

... **Robert R. Radcliffe**, SM '82, reports from West Chester, Pa.: "I went to work for Commodore Business Machines in April 1990 as an applications manager of Unix products in the Commodore Applications and Support Group. We are responsible for application software strategy and tactical implementation for Commodore PC, Amiga, Amiga Unix, and compact disk technologies on a worldwide basis." ... **David Fullerton**, SM '78, writes: "My wife gave birth to our second baby in September. We now have a two-and-a-half-year-old boy and a baby girl!" ... Word from **John L. Weisz**, SM '87, living in Shaker Heights, Ohio: "I'm currently working for BP America and I recently took a new assignment as a petroleum products trader."

... **Michael Thiel**, SM '71, sends news: "After a dozen years consulting in energy, oil, gas, and strategic planning, I started my own company in the travel field in 1980. Hideaways International, a travel club with about 11,000 members nationwide and internationally, helps clients plan off-the-beaten-path vacations (villa rentals, castles, yacht charters, etc.). Six times a year we publish a magazine/newsletter called *Hiddenways Guide*."

Greg Eckstein, SM '87, is "still working at Data General as a senior product manager." ... **Jillian Kurtz Temkin**, SM '88, sends word from New York City: "On October 6, 1990, I was married to Jeremy Temkin, a fellow graduate of Haverford College and UCLA School of Law." ... **Michael Schnitzer**, SM '79, reports: "Over a decade at Putnam, Hayes & Bartlett, Inc., in Cambridge. No news!" ... **Ken Kershner**, SM '88, and **Jane Ginsbury**, SM '87, announced their engagement on November 10, 1990. They plan to be married in the fall of 1991 in California. ... **Nick Fiekowsky**, SM '78, writes from Plano, Tex.: "I have been at American Airlines Sabre Computer Services for the past year, working as principal technologist in the Advanced Technology Group. The job is fabulous—what I've dreamt of doing since I first laid my hands on a computer 20-plus years ago. Heavily involved in commercial supercomputing (less of an oxymoron each year) and organizational issues. Trying to find enough time to enjoy the travel benefits."

... **Krishna Challa**, PhD '74, reports: "In July 1990 I assumed the po-

sition of chief of the Trade, Finance and Industry Division, for Latin America and the Caribbean-3 at the World Bank in Washington, D.C. I'm developing an interest in the application of real options theory in development economics/finance."

Diana J. Durnford, SM '85, writes: "After a very interesting year last year working for Senator Moynihan in Washington, D.C., on international environmental issues, I moved back to Canada. I am now working for M.C. Larson & Associates, a start-up strategy consulting firm. It is very challenging and lots of fun! I have simultaneously pursued my political interests by joining David Berger's (liberal MP) board of directors and policy committees." ... **Marcy Krolkowski Blais**, SM '77, reports: "I was married on September 15, 1990 to Gilbert Blais and am now managing the Reading, Mass., office of Coldwell Banker Residential Real Estate." ... **Paul Appleby**, SM '87, writes: "In June I was married, moved to Connecticut, and became a product manager for M.B.I. in Norwalk. M.B.I. is a direct mail marketing company." ... **J. Thomas Gormley III**, SM '87, sends word from San Francisco: "I'm still working at Oracle Corp., where I was promoted to product manager. I'm engaged to be married in June 1991." ... **Steven Pollack**, SM '87, is currently working at Transohio Savings Bank, heading the mortgage-backed securities section. He was expecting a second child around Christmas."

Brian Harris, SM '90, has joined the Index Group in Cambridge, Mass. ... **Susan H. Martin**, SM '90, sends word: "I am very much enjoying the transition to life in London and to a real job. Delighted that Morgan Stanley unexpectedly sent **Maria Karahalas**, SM '90, to London for several months—we've been trying our best to lighten these Brits up a bit. Saw **Graham N. O'Keefe**, SM '90, several weeks ago—suddenly his accent sounds less foreign than mine! News from **Scott Halstead**, SM '90, is that he's loving his job at Booz-Allen, even though he's been spending all of his time in Iowa City."

... **Daniel Villiger**, SM '88, writes from Horgen, Switzerland: "I joined the Zurich Insurance Co. in January 1990. I'm currently in charge of designing and running executive education programs for our senior management worldwide." ... **Martin R. Strasmore**, SM '73, reports: "Many changes—the family spent August in India and Kassandra and I were trained and certified to teach a one-day Siddha meditation workshop (80 teachers from 29 countries were certified). On October 1, I started my own company in Darien, Conn., called Silvermine Consulting Group. It is fun to create a new business that seems to be offering what American industry needs—a multifaceted approach to improving the new product development and commercialization process. I enjoy getting involved in interesting technologies and applying good sound management common sense."

Dick Rothkopf, '68, sends word from Chicago, Ill.: "Four great children aged 3 to 21. Spend about a month per year in Europe with family; lived there for eight years after leaving Sloan School. Whole family does lots of biking. I am the owner & president of a company that sells products and services by direct mail—our major clients are American Express, Sears, and Discover Card." ... **Mary N. Young**, SM '79, writes: "I have started up a Boston office for the CIT Group/Business Credit, Inc., a finance company subsidiary of Dar Ichi Kangyo Bank and Manufacturers Hanover Trust Co. I enjoyed visiting with **Linda A. Jensen**, SM '79, **Linda K. Smith**, SM '79, **Diana Mackie**, SM '79, **Cecelia d'Oliveira**, '77, **Betsy A. Monrad**, SM '80, and **Carol Bogin**, SM '79, recently, and **Andy Gralla**, SM '79, before reunions last summer." ... **Marc D. Mitchell**, SM '85, reports: "I recently returned to Boston after 18 months in Indonesia where I was a consultant to the national family planning program. I have now returned to Management Sciences for Health as deputy director of a \$42 million worldwide family planning project."

Ellen B. Epstein, SM '77, writes: "In May I received my JD from the Northeastern University

... **Thomas A. Gardner, Jr.**, SM '88, was recently promoted to the rank of commander. He is currently assigned to the under secretary of the Navy as an administrative aide and is working primarily as an analyst of defense budget matters. ... **Howard P. Sharp**, '34, reports that he is retired and has a winter address on Amelia Island Plantation in Florida. ... **Sue Bailey**, SM '87, and **Mitch Hardy** announce the birth of their son Douglas on August 31, 1990. Sue is treasurer of the Northeast Mass. Regional Recycling Committee which helps the 14 member communities set up local recycling centers. ... **Elizabeth Coley**, SM '87, reports: "I am still at UCSD Medical Center. I am becoming very involved in the current movement in health-care systems to adopt and adapt the notion of total quality management. We are developing our own version of a continuous improvement plan: our quality management process. It is interesting and challenging to be in the midst of a dramatic

School of Law. I am currently working at Sugarman, Rogers, Barshak & Cohen in Boston, and will be a clerk for the Massachusetts Superior Court for the 1991-92 term." . . . **John Becker**, SM '85, sends word from Glencoe, Ill.: "I have left McKinsey & Co.'s Chicago office and am now director of strategy for Kraft U.S.A. Operations." . . . **Barnaby Sheridan**, SM '84, writes: "I moved myself, my wife, and our 7-month-old daughter, Paige, to Portland (Oregon!) to join Sequent Computer Systems in their Information Services Department." . . . **Michael Halloran**, SM '83, had a little girl, Kylie Marie Halloran, on August 3, 1990. . . . From Los Angeles, **Jim Pastoriza**, SM '88, writes: "After spending two years trying to think of new businesses, I have moved west in pursuit of the American dream. I continue in the employment of the phone company, only now in sales. I have done no work lately for the Federal Accounting Standards Board (F.A.S.B.). **Steve Mankoff**, SM '88, tells me he now serves as the MIT alumni F.A.S.B. representative." . . . **Paul K. Stedman**, SM '89, was recently engaged to Martha Alston Mook. They are to be wed July 6, 1991.

Carlos Mateo, SM '89, writes from Old San Juan, Puerto Rico: "I'm still working for the Pampers Brand group. A second baby coming in April '91. Enjoying great surfing in the Caribbean Sea." . . . **David N. Tso**, SM '74, has been promoted to general manager of East-of-Rockies Supply at BP North America Petroleum, Inc., in Houston. . . . **David Sartorius**, SM '90, is working as a senior manufacturing engineer in a rapidly growing manufacturing division of Air Products & Chemicals, Inc., in Bethlehem, Pa. . . . **Jeremy Cohen**, SM '88, sends word: "My wife Penney and I have recently moved to Atlanta. I am still working at IBM and Penney is working at Hemophilia of Georgia." . . . **Donald Ravey**, SM '61, writes in from San Mateo, Calif.: "I took early retirement when Unisys closed the plant where I worked for 14 years. Doing some consulting and part-time teaching, traveling and enjoying life." . . . **Stanley Zalkind**, SM '64, is living in La Jolla, Calif., where he is president and founder of Quest Technology Corp., a two-year-old ceramic injection molding company." . . . **Jeff Wickham**, SM '84, reports: "I still haven't been able to drag myself away from New England. I'm enjoying my work as a consultant in logistics and customer service for Arthur D. Little in Cambridge. Best regards to friends from SM '84."

Mats G. Lindquist, '77, writes: "I am the president of Paralog AB, a leading supplier of software for content-based retrieval (CBR) systems. I also hold the position of president of the U.S. subsidiary Paralog, Inc., in Connecticut, founded in September 1990. Paralog has customers in over 20 countries worldwide, including the People's Republic of China. In the U.S., the initial market focus will be chem/pharma, automotive, and office applications. I live in Stockholm with my wife Karin. My two daughters, Maja and Lina, are now 20 and 19 and doing fine." . . . Back in November **Andrew Mark Grimalda**, SM '86, sent word: "I am now VP & CFO for an insurance company after teaching three years in the Social Sciences Department at West Point. I left active duty in 1989 and joined the National Guard in Florida. I was called back to active duty in October and am the company commander of the 743rd Maintenance Unit in Saudi Arabia. I'm a captain in the Army and soon will make major. My wife Margaret and I have two sons, Christopher, 2 1/2, and Matthew, 1, future West Point cadets. Hopefully I will only be in the Middle East six months but more like one year. Hope to be back soon." . . . **Gregory Zaic**, SM '72, reports: "I am a venture capitalist with Prince Ventures in Westport, Conn. Our firm specializes in early stage medical and life science investment opportunities." . . . **Clarence "Cap" Jacobs**, SM '77, is the managing director of Jacobs & Associates, Ltd. in Napier, New Zealand. The company does catalogue mail-order marketing. . . . **Harvey Berger**, SM '76, sends word: "I am a partner in a San Diego law firm, Haasis, Pope & Correll,

specializing in civil litigation. My wife Janice Mulligan is also a lawyer. Our daughter Vanessa, 2, is already adept at the art of cross examination. Our house is big, San Diego weather is beautiful, and all old friends are welcome!" . . . **Michelle de Nevers**, SM '81, is working as a senior economist in country risk analysis for the World Bank in Washington, D.C. She has one son, Nikola. . . . **Jim Wood**, SM '68, writes: "Raising three kids ages 5 through 12, most happily married, just finished a house addition and a third book of poems—now beginning to look for a publisher for this one. Working as an editor at the University of Massachusetts/Amherst and one or two other things. What's up, Waverly?" . . . **David Pomerantz**, SM '81, sends word from Wakefield, Mass.: "I was recently married to Cindy Zatz of Newton, Mass. I've been working as an independent consultant on the Macintosh since the beginning of 1989, writing software and consulting on technical strategy."

Richard Manhardt, SM '86, announces the birth of their second child, Carl, born in Mesa, Ariz., on September 6, 1990. . . . **Carl P. Lehner**, SM '80, writes: "Sandra and I are now well settled into life with three children. We have finally realized that while three children are wonderful, they are also enough. I was named president of Leigh Fibers this year, and thus am even busier than ever. Is anyone else from Sloan now in the textile industry, other than E.C.P.I.?" . . . From New York City, **Karen and William Herdan**, SM '90, announce the arrival of Adriana Herdan, born on October 7, 1990. . . . **Lee J. Tesconi**, SM '83, married Carol Snow in October 1990. He is currently a VP at Banc Boston Capital, investing in LBOs. . . . **Martin M. Gottlieb**, SM '90, is working as a process supervisor at Hewlett Packard. . . . **Edward J. Bartos**, SM '78, is an area sales director for Novell. . . . **Joseph W. Chow**, SM '81, is VP of State Street Bank and living in Brookline with Selina Chow and Joanna, 4, and Jason, 2. . . . **Edward N. Dodson**, SM '61, reports: "I am still director of economic planning & resources at General Research Corp. I also teach engineering economics at the University of California at Santa Barbara."

Harold Sharon, SM '84, has a new job at E.M. Warburg, Pincus & Co. He is assistant portfolio manager for Counsellors International Equity Fund. . . . **Kazutoshi Ogawa**, SM '89, writes in from Hong Kong: "Recently, I had to get a new passport although the old one had not expired because all the pages of the old were filled with entry and departure stamps. Almost every two weeks I travel to Bangkok, Sydney, Singapore, and other Asian cities. It seems Asia is still doing well in terms of economy compared with the U.S. and Europe. I might be so lucky as to be able to do businesses in this dynamic region." . . .

Carlos Federico Carballo, SM '89, writes: "Last September I joined Booz-Allen & Hamilton's Madrid office. Since then I've worked on a couple of projects involving more than one European country (Pan-European). Sometimes I feel that I am still at Sloan, working in a team with people from different cultures and doing an analytical type of job." . . . **Swati Dasgupta**, SM '89, is working as a senior product manager at Digital Equipment Corp. . . . **Sean G. Brophy**, SM '90, is living in Ontario, Canada, where he is a manager of Product Line Planning for Northern Telecom Ltd. He works with wireless and personal communications services and opportunity analysis and planning. . . . **David Edington**, SM '87, reports: "I am working hard as VP and portfolio manager at Pacific Investment Management Co. in Newport Beach, Calif." . . . Rear Admiral **Ronald J. Zlatoper**, SM '75, USN, wrote to us last November: "I am currently the battle group commander for a Navy aircraft carrier battle group that is proceeding to the Persian Gulf and North Arabian Sea in support of Operation Desert Shield. Moved to California from Washington, D.C., this past July to take this new job. My wife, Barry, and two high-school-age children accompanied us." . . . Word was sent from New York City

that **Mitchell W. Hedstrom**, SM '77, was married on April 28, 1990, to Zöe Dyson of Warwick, Bermuda. . . . **Robert W. Norris**, SM '63, reports: "Since 1981 I have been a class teacher in a Rudolf Steiner School in Great Barrington, Mass. I came to this profession after several years as owner/operator of a distribution company in Scandinavia. It was there I placed my own children in this marvelous type of school. Eventually, after seven years, I sold my business, trained in England for two years, and became a Steiner teacher. I teach math, history, science, reading, writing, painting, and movement for the same class from first to eighth grade. I've completed one cycle and am now back teaching first grade again."

Enrique Garcia Corona, SM '66, writes: "I am president of Pigmentacion Tecnica, S.A., a manufacturer of powdered pigments and master batches for the plastics industry, as well as distributor of plastic resins in Mexico City." . . . **Kent A. Wallgren**, SM '88, is a marketing manager at Globex in New York City. He is responsible for the implementation of Globex, an after-hours automated trading system for the futures market in the U.S. . . . **Lisa M. Dickinson**, SM '77, sends word: "Last April I made a welcome move from New York City to the Charlotte, N.C., area. A week later I was diagnosed with leukemia which I am successfully fighting. I am now back to work at my new job at the DuMond Co., selling used plant facilities and equipment around the world." . . . **Sarah Shoaf Cabot**, SM '85, writes: "I have taken leave from the biotechnology licensing field to pursue a degree in law from the University of Pennsylvania." . . . **Paul R. Freshwater**, SM '68, reports: "I am a regional public affairs manager for Procter & Gamble. I'm on the Board of Charter Committee of Greater Cincinnati and chair of the only Sea Scout Unit in the region (thanks to my MIT Sailing Club training)."

After one year at Eli Lilly & Co. **David E. Finnell**, SM '87, has a new title: operations associate in Dry Products Packaging. His duties are to supervise the work force in the production finishing area for pharmaceutical products. . . . **Gregory Zaic**, SM '72, sends word from Ridgefield, Conn., that he is a general partner in Prince Ventures, a venture capital firm specializing in medical & life science investments. . . . **Michael Rothkopf**, PhD '64, is currently a professor at Rutgers University in the School of Business and at RUTCOR, the Rutgers Center for Operations Research. . . . **Jason S. Rubin**, SM '84, is living in Seattle where he was recently named VP for communications at Immunex Corp. . . . **Jill D. Smith**, SM '85, has been promoted to VP at Bain & Co. in Boston. She was formerly a consultant for the company. . . . **Alan R. Fushfeld**, '75, is now CEO of Generics, Inc., in Waltham, Mass. He had been senior VP of the Cambridge-based Pugh-Roberts Associates, Inc. . . . **Theresa M. Stone**, SM '76, is senior VP of the Chubb Corp. in Warren, N.J. Previously she was a principal in Morgan Stanley & Co.'s Mergers & Acquisitions Department.

Dean L. Wilde, Jr., SM '80, has become a director of Temple, Barker & Sloane/Strategic Planning Associates in Lexington, Mass. He continues as executive VP of Strategic Planning Associates in Washington, D.C. . . . **Howard W. Bell, Jr.**, SM '73, has been named chair of the board of trustees for the Greater Cincinnati Television Educational Foundation. Bell has extensive professional expertise in the areas of banking, real estate development, and educational administration. He continues working as VP for Administrative Services at the University of Cincinnati. . . . **Ken N. Morrison**, SM '70, has been named senior VP of NCNB Support Services, Inc., in Dallas, Tex. Since 1981 Morrison had served as the bank's VP. NCNB Texas has more than 300 banking locations in 79 Texas communities. . . . **Dennis B. Sullivan**, SM '86, has been appointed director of taxes for Alfred W. Siegrist, CPA, PC, an accounting firm located in Wellesley, Mass. Sullivan, a CPA and attorney, is responsible for directing the firm's individual and business tax and financial planning services, including business valuations.

David E. Labson, SM '63, of Purchase, N.Y., died on November 23, 1990. He founded Health Industries Research of Wilton, Conn., and was known as a pharmaceutical marketing research specialist. Labson was president of Temple Sinai in Stamford, Conn., from June of 1989 to his death, and was the past president of the temple's Brotherhood. He served in the U.S. Army and coached the Darien eighth grade travel basketball team for many years.

Sloan Fellows

Larry Atha, SM '82, sends word from Huntsville, Ala.: "Patty is writing a novel full-time and enjoying it. Our son Larry II received his BS in mechanical engineering from Auburn University last December." . . . **Ignacio Avellaneda**, SM '67, writes: "I am to receive a PhD in history from the University of Florida next December. My area of specialization is colonial Latin American history and I intend to do consulting work on early contact period studies, Spanish borderland studies, and any other topics related to Spanish influence in today's United States, possessions and territories." . . . **John R. Harrauld**, SM '78, is an associate professor of engineering management in the School of Engineering & Applied Science at the George Washington University. . . . **Irving Skorka**, SM '69, writes from Scarsdale, N.Y.: "In addition to my activities implementing Total Quality Management initiatives at Loral Electronic Systems, I also have been appointed director of the Publications Department." . . . **Ronald L. Turner**, SM '77, is president and CEO at Gel-Marconi Electronic Systems Corp. in Wayne, N.J.

From Manchester, Tenn., **Donald W. Male**, SM '58, sends word that last April he was elected to the board of directors of the Unitarian Universalist United Nations Office. . . . **R. Bryan Erb**, SM '68, was awarded an honorary DSc this past June by the University of Alberta for his contributions to aerospace. Erb works at NASA's Johnson Space Center in Houston, Tex. . . . **Tatsuo Terasawa**, SM '80, writes: "Since 1987 I have been representing the Shimizu Corp.'s Los Angeles office engaging in various business transactions between the U.S. and Japan. This includes set-ups of several joint venture corporations in Japan. Recently I established an office of a research company called SC Research Center, Inc., for making better exchanges of practical managerial, marketing, and technological information and business opportunities." . . . **Leroy E. Day**, SM '60, is continuing to consult in both the domestic and foreign aerospace fields. . . . **James G. Groszklaus**, SM '76, is executive VP of Kimberly-Clark Co. in Roswell, Ga. . . . **Gary L. Burkhart**, SM '82, has been appointed executive director of the Electronic Manufacturing Productivity Facility (EMPF) and associate dean of the Purdue School of Engineering and Technology at Indiana University-Purdue University at Indianapolis. Burkhart will report to the EMPF's board of directors, which consists of executives from IUPUI, the Navy, and industry. He will be responsible for all research, development, and technology transfer efforts performed by government, university, and industry personnel involved in the consortium. Established in 1984, EMPF teams with the American electronics industry to perform R&D in electronics manufacturing materials, processes, and process controls.

Harrison T. "Bing" Price, SM '55, sends word from Sun City, Ariz.: "I don't expect any of this to be printed (how much news can one generate in retirement?). After a career with GM in manufacturing and engineering, my retirement is a return to my music background—in jazz bands and the Sun City Concert Band (where I am concertmaster). Some of the 1955 Sloan Class may recall some piano and singing feats at the Faculty Club." Seems pretty interesting to us!! . . . From Westerville, Ohio, **Conrad F. DeSieno**, SM '60, reports that in July 1988 he retired from American Electric Power Service Corp. as VP for Rates. . . . **John H. Mason**, SM '90, joined Tenera as a VP where he provides engineering and manage-

ment consulting to the energy industry. . . . **Neil R. Vander Dussen**, SM '70, has become vice chair of the Sony Corp. of America. Prior to this he was president and CEO for the New York City-based firm. . . . SciTrek, the science and technology museum of Atlanta, has received a \$20,000 gift from Northern Telecom in honor of the museum's second anniversary. **Jere A. Drummond**, SM '79, executive VP of BellSouth Services, Inc., and chair of SciTrek's board, received the check from a Northern Telecom representative. SciTrek is a nonprofit, private, physical science center that houses over 100 interactive exhibits. Since opening in October 1988, SciTrek has welcomed more than half a million visitors.

Lawrence B. Zahner, Jr., SM '89, is now the production manager for the Reatta Craft Centre, Cadillac Motor Car Division, BOC, General Motors Corp. He was previously director of N-Car Planning for the BOC Lansing Automotive Division of GM. . . . **H.G. "Herb" Webb**, SM '73, has joined HDR Engineering, Inc., as a senior railroad consultant in the company's Chicago office. Prior to joining HDR, Webb was assistant VP and chief engineer with the Atchison, Topeka & Santa Fe Railway Co. He is also a former president of the American Railway Engineering Association. . . . **Feliciano Giordano**, SM '78, program executive officer for Strategic Information Systems at the U.S. Department of the Army, was one of the top federal workers honored by President Bush as a recipient of the 1990 Distinguished Rank Awards. Giordano received \$20,000, the highest award bestowed in the prestigious Senior Executive Service. The awards are presented annually to federal managers for extended exceptional performance in government. According to a government press release: "Giordano has been recognized by the Army for consistently generating millions of dollars of cost savings initiatives as a result of his ability to combine innovative acquisition vision with sound business acumen." . . . **Philip R. Sayre**, SM '73, has assumed the day-to-day operating management of Butler Automatic, Inc., in Canton, Mass. Before joining the company, Sayre was the chair and principal of Sayre Management Sciences, a consulting practice specializing in strategic planning, organizational development, asset management, and manufacturing efficiency in the printing industry.

Warren A. Welsh, SM '60, of Fulton, Mo., died on October 6, 1990. Welsh became a 1st lieutenant while serving in the U.S. Signal Corps during WW II. While in the service he had extensive training in advanced electronics and radar at Harvard and MIT and helped prepare patent applications covering developments made by researchers at the Radiation Lab at MIT. In 1947 Welsh joined the Western Electric Co., part of the Bell System, and continued there until his retirement in 1975. His first work for the company involved the design of equipment for testing the manufactured product—principally radar, military computers, and missile guidance systems. Upon retirement Welsh moved to a farm in Fulton where he raised purebred Beefmaster cattle and worked at his lifelong hobby of photography.

Richard C. Samuelson, SM '61, of Palm Springs, Calif., died on August 7, 1990. Samuelson was the owner of a food manufacturing business. His wife, Maryann Choppy Samuelson, commented that the most wonderful year in their lives was spent at MIT. . . . **John H. Thatcher, Jr.**, SM '42, died on September 10, 1990, in Santa Barbara, Calif. He spent most of his professional life with Standard Oil Co. of California in a variety of managerial positions, generally in the Producing Department. His year at MIT was followed by three years in Washington, D.C., first with the War Production Board, then as personal assistant to Ralph K. Davies, Petroleum Administrator for War, and finally as executive secretary of the latter division. At the end of World War II he returned to San Francisco and worked with SoCal heading up a number of its subsidiaries until his retirement in 1973.



K.N. Morrison F. Giordano H.G. Webb

W. Gardner Barker, SM '37, of Marblehead Neck, Mass., died on November 2, 1990. Barker was former president and CEO of the Thomas J. Lipton Co. He began his business career as a market research analyst at Lever Brothers. He served in the Navy during World War II, and joined Lever Brothers upon his return. After several years as executive VP with the Simoniz Co. in Chicago, Barker joined the Lipton Tea Co. as VP for new products. He was elected president and CEO of the firm in 1959 and retained the positions until his election as chair of the board in 1972. He retired in 1978, but remained on the board of directors until 1984. An avid sailor, Barker was instrumental in developing and maintaining film footage of all the America's Cup races after World War II. The America's Cup was begun by Sir Thomas Lipton, founder of the company bearing his name. Barker and his family sailed off the coast of Eastern Canada and New England. He served as commodore of the Eastern Yacht Club in Marblehead and was a member of several other yacht clubs.

Senior Executives

Jack Wexler, '71, writes in from Vero Beach, Fla.: "After retiring in 1982 from Esso Eastern, Inc., (Exxon affiliate) where I had a variety of operating and managerial assignments in the Far East and the U.S., I settled in Florida. I continue to be involved in international business through consulting work and serving on the boards of several companies. My principal engagement is with Nabors Industries, an international oil and gas contract drilling company. I'm also active in our local center for the arts where I served on the board of trustees and chaired the finance committee. I'm looking forward to a class reunion in 1991." . . . **Raymond V. McMillan**, '83, sends word from Tewksbury, Mass.: "I am a VP of CTA, Inc., a \$100 million aerospace information systems corp. located in Rockville, Md." . . . From **Arthur L. Money**, '88, in Cupertino, Calif., we hear: "Since January 1990 I have been president of ESL, Inc., a subsidiary of TRW. ESL employs 2,500 people and is a \$350 million-per-year defense electronics company. Located in Sunnyvale, Calif., it is a leading-edge technology system integration defense electronics leader."

Alain B. Croux, '90, sends word from Montesson, France: "In 1991 Eurolysine is expanding its production capacity of threonine, therefore reinforcing its position as a world leader in the production and marketing of the amino acid used in the animal feed market." . . . **Roger Onorati**, '81, writes in from Annapolis, Md.: "I recently started my own business working as an independent business consultant specializing in organizational development, strategic planning, and as an agent for Praendex Midatlantic, in providing support to business executives through the predictive index system." . . . **Karl F. Lang**, '61, reports: "I recall fond memories of my stay at Endicott House in 1961. I'm enjoying retirement with my wife at Messiah Village (a lifetime retirement community) in south central Pennsylvania." . . . **Donald D. Osborn**, '79, is VP for operations at Camcar/Textron in Rockford, Ill.

From Vienna **Edwin Frieser**, '88, writes: "My present position is CEO of ROHE/Austria, a 200-person company serving the international gasoline companies and the automotive aftermar-

ket. Joint ventures are presently being discussed with Poland, Romania, and Hungary. I spent one month at Ohio's famous Miami University on invitation, lecturing on 'former east block' changing rules and upcoming new international business and how to prepare for it." . . . **John F. Dexter**, '70, retired from Dow Corning Corp. in 1981 and is living in Midland, Mich. . . . **Robert H. Denien**, '83, is a senior VP for programs in the Aircraft Systems Division at Grumman Corp. in Montgomery, Penn. He's the former president of the company's Long Life Vehicles Division. . . . **David S. Hollingsworth**, '70, has retired as CEO and chair of Hercules, Inc., in Wilmington, Del.

The Alumni/ae Association has been notified that **Joao Fabio de Carvalho Serapiao**, '88, of São Paulo, Brazil, died November 20, 1990. He was the VP for marketing and R&D at Toga. There was no further information provided.

XVI AERONAUTICS AND ASTRONAUTICS

Robin Vaughan, SM '83, sends word from Montrose, Calif.: "I am a member of the technical staff in the navigation systems section at the Jet Propulsion Lab. I'm currently working as an opti-

cal navigation analyst for the *Galileo* navigation team. *Galileo* recently flew by earth and will encounter the asteroid Gaspra in October 1991. I am responsible for planning and processing optical navigation pictures for these encounters." . . . **Seddik Belyamani**, SM '72, is VP for international sales at Boeing Commercial Airplane Group. He lives in Redmond, near Seattle, with his wife, Prudence, and two children, Mona, 20, and Samir, 17. . . . **Oktay Yesil**, SM '70, reports that he is still with Boeing Commercial Airplane Group in Seattle. He is now with the 777 (the company's newest aircraft family) in Noise Engineering. As a technical leader and engineering scientist he conducts various acoustic evaluation tests at Boeing's Noise Lab to support the interior design configurations for the new plane.

James A. Martin, EAA '69, writes: "I am spending 12 months at NASA's Johnson Space Center as the representative of NASA's Langley Research Center on the lunar-Mars space exploration initiative." . . . **James Blissit**, SM '86, sends word from Tiefenbach, Germany: "From 1986-89 I worked on technology issues for the Air Force System Command's Foreign Technology Division, based in Japan and operated throughout the Pacific Basin. Since 1989 I've been an F-16C fighter pilot, based in the Federal Republic of Germany." . . . **Jeffrey R. Kurland**, SM '70, writes: "I became co-founder of Digitran Corp., a newly created interexchange carrier specializing in switched high-speed data services. Our new company is headquartered in Rockville, Md., with offices in New York and soon to open in Chicago and Los Angeles." . . . **Robert Cayleff Weiss**, SM '74, was named manager of Supply Operations at Amerada Hess Corp. in New York City. . . . **Myron Kayton**, PhD '60, had his newest book published last June, *Navigation: Land, Sea, Air, and Space* (IEEE Press, 1990).

Eugene F. Mallove, SM '69, chief science writer in MIT's News Office has been honored by the Astronomical Society of the Pacific. His second book, *The Starflight Handbook* (John Wiley & Sons, Inc., 1989), has been selected by the Society as one of their Astronomy Books of 1989. Mallove's third book, *Fire from Ice: Searching for the Truth Behind the Cold Fusion Furor* (John Wiley & Sons, Inc., 1991), has an early summer publication schedule. Mallove has been very busy with other projects as well. He helped write and edit the physics section of the *Almanac of Science & Technology* (Harcourt Brace Jovanovich, 1990), and he contributed a major non-fiction chapter on Mars exploration for a soon-to-be published science fiction novel, tentatively entitled *The Cloud Man*. The book is part of an Isaac Asimov series called the New Wave Series of science fiction novels, which aims to combine science fiction books with non-fiction background material.

Paul G. Kaminski, SM '66, has been named a new Draper Lab corporation member. He is president and CEO of Technology Strategies & Alliances, a strategic investment banking firm focusing on the creation of alliances between established companies and emerging high technology firms. He co-founded the company in 1985. One of Kaminski's several government and private industry affiliations has been serving as a consultant and advisor to the under secretary of defense for research and engineering. . . . **Robert C. Seamans, Jr.**, ScD '51, Course XVI senior lecturer, and **Sheila E. Widnall**, SM '60, MIT's Abby Rockefeller Mauze Professor of Aeronautics and Astronautics, are two of the 12-member Charles Stark Draper Prize Committee. The prize, first presented in 1989, honors "those whose engineering innovations and their reduction to practice have contributed to human welfare and freedom." The next recipient, who will be named in October, will receive a certificate, a gold medal, and an honorarium of approximately \$375,000.

Andrew W. Lewin, an MIT senior from Palatine, Ill., has been selected to receive the General James H. Doolittle Scholarship in Course XVI. Lewin is the fifth recipient of the scholarship. Professor **Earl M. Murman**, department head, made the award announcement and said "We

regard the scholarship as a highly prestigious and valuable award. We appreciate the financial support which Allied Signal Corp., Bendix Aerospace, and General Doolittle have provided." **James H. Doolittle**, ScD '25, is the aviation pioneer who led the first US air strike against Japan in the early days of World War II. . . . At another Course XVI ceremony, Professor Murman and Assistant Professor **Harold L. Alexander** presented the NSF "Incentives for Excellence Scholarship Prize" of \$1,000 to **Thomas Washington**, '92. The prize is intended to recognize outstanding minority students in science, engineering, and mathematics, and to encourage them to pursue advanced study in these fields. The prize comes through the NSF's Minority Graduate Fellowship program.

Raymond Wexler, SM '39, of Silver Spring, Md., died on October 15, 1990. Wexler was a retired NASA meteorologist who had specialized in radar and satellite meteorology. He was a meteorologist for Northwest Airlines in Spokane, Wash., before World War II, then worked during the war and immediately afterward as a meteorologist for the War Department. His duties included teaching meteorology, navigation, and weather map analysis to Army Air Forces cadets, studies of chemical gas dissipation, and work on radar weather. In 1948 Wexler studied meteorology at Imperial College in London on a Fulbright fellowship, then returned to this country to work in a variety of meteorological assignments for Harvard and MIT. He also did hurricane research at Woods Hole, Mass. He moved to the Washington area and joined the staff at Goddard Space Flight Center in 1970 after having worked as a meteorologist at Allied Research, Inc., in Massachusetts. He retired from NASA in 1983.

XVII POLITICAL SCIENCE

From Washington, D.C., **P. Brett Hammond**, PhD '80, sends word that he is a study director for the Committee on Mandatory Retirement in Higher Education at the National Academy of Sciences. As of January 1, he has been director of academy studies for the Academy of Public Administration.

. . . **Paul F. Walker**, PhD '78, co-director of the Cambridge-based Institute for Peace & International Security, has given lectures at Mount Union College in Alliance, Ohio, and before the Worcester, Mass., Poor Supper participants. Both talks addressed his ideas about the United States and post-Cold War priorities. He argues that more money traditionally spent on defense should be allocated to fight our nation's domestic threats. . . . **Peter M. Haas**, PhD '86, assistant professor of political science at the University of Massachusetts at Amherst, has written *Saving the Mediterranean: The Politics of International Environmental Cooperation* (Columbia University Press, 1990). The book addresses the policies encouraged in the 1980s by the Mediterranean Action Plan that saved the sea from becoming an environmental disaster.

XVIII MATHEMATICS

Lenore Blum, PhD '68, and **Manuel Blum**, '59, send word from Berkeley, Calif.: "Lenore and I are proud to announce that our son **Avrim**, '87, got married last June to his long-time fiancée, **Michelle Kirshen**, '87 (VII). Avrim and Michelle met their first day as freshmen at MIT, and got serious about each other as sophomores. Michelle will be getting an MD this coming June from Emory at the same time that Avrim gets a PhD in EECS from MIT." . . . **Kenneth S. Alexander**, PhD '82, was promoted to associate professor of mathematics at the University of Southern California last September. . . . **Lance J. Fortnow**, PhD '89, reports that he married **Marcy Appell** on September 2, 1990. He is currently in his se-

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cond year as assistant professor of computer science at the University of Chicago.

Paul B. Coggins, '55, writes: "In retirement I have, for the past few years, been the mathematics tutor at the Pass-a-Grille Church Clinic in St. Pete Beach, Fla. I currently have about 20 students, ages 10 through 20, whom I tutor in arithmetic, algebra, geometry, and trigonometry. Lots of fun!" . . . **Alan M. Zaslavsky**, PhD '89, is an assistant professor in the Department of Statistics at Harvard University. . . . **Richard Hill**, '73, sends word from Switzerland that he has written and had published *EDI and X.400 Using Pedi* (Technology Appraisals). The book is an explanation of how CCITT Recommendation X.435 can be used to provide Electronic Data Interchange services. It is available only by mail order from the publisher in London. . . . **Ira M. Gessell**, PhD '77, has been promoted from associate professor to professor in the Department of Mathematics and Computer Science at Brandeis University in Waltham, Mass. . . . **Gary R. Jensen**, '63, professor of mathematics, has been appointed chair of the Department of Mathematics at Washington University in St. Louis, Mo. As mathematics chair, Jensen says a re-evaluation of the curriculum and the search for new faculty are his immediate concerns. A specialist in differential geometry, he joined the university's mathematics faculty in 1970. He previously taught at Carnegie-Mellon University and the University of California at Berkeley. . . . **Herman Chernoff**, MIT professor emeritus of applied mathematics, has been selected Statistician of the Year by the Boston Chapter of the American Statistical Association. Chernoff has been on Harvard University's faculty since his MIT retirement. Of the award, he said, "Recognition by your colleagues is always a pleasant experience. However, I fear it's a sign of old age because the older I get, the more awards I receive."

XX APPLIED BIOLOGICAL SCIENCES

Arthur E. Humphrey, SM '60, T.L. Diamond Professor of Chemical Engineering and director of the Center for Molecular Bioscience and Biotechnology at Lehigh University in Bethlehem, Penn., began a one-year term as president of the American Institute of Chemical Engineers on January 1. He automatically assumed the presidency following his election last year as VP of the 83-year old, 50,000-member society. In addition, Humphrey chaired the U.S. and Japan's third biotechnology symposium at the East-West Conference in Honolulu, Hawaii, held last January.

XXI HUMANITIES

Rosalind McFarland Williams, associate professor in MIT's Writing Program, has been selected to hold the Class of 1922 Career Development Professorship. She will hold the chair until June 30, 1992. . . . **Loren R. Graham**, history of science professor in MIT's Science, Technology & Society program, has edited *Science and the Soviet Social Order* (Harvard University Press, 1990). The book examines how science and technology have been integral to the development of Soviet culture within the past two generations as the USSR moved from a peasant society to an industrialized superpower. . . . **Susan D. Fischer**, PhD '72, and **Patricia A. Siple** have recently written *Theoretical Issues in Sign Language Research: Volume 1: Linguistics* (University of Chicago Press, 1991).

Ken Keniston, director of MIT's Science, Technology & Policy program, received a \$4,000 check from the GTE Government Systems Corp. The grant was awarded to Keniston by Jerold T. McClure, '63, (VI), manager of business acquisition and planning in GTE's Command, Control, and Communications Systems Sector, under the GTE Foundation Lectureship Program for a series

of lectures on "Technology and Ethics." With the grant, Professor Leon Trilling (XVI) led a five-day series during the January 1991 IAP entitled "Ethics, Technology, and Public Policy." The series was very successful, with 25 students enrolling and up to 40 people in each of the audiences.

The Alumni/ae Association has been notified that **Robert B. Rardin, II**, PhD '75, of Oxford, Ohio, died on October 9, 1990.

XXII NUCLEAR ENGINEERING

Sasson Guy, SM '90, writes: "I am working for Shell Oil Co. in France, in the Department of Quality Management. Quality control is one priority of Shell France. Our focus is now the reliability and quality of our softwares as well as the quality of the Department of Information Systems. It is a challenging issue and a very interesting first job." . . . **Susan E. Cooper**, PhD '88, married Eric M. Klier, SM '88, (III), on October 6, 1990. . . . **James K. Liming**, SM '83, sends word: "In June 1990 I joined Erin Engineering & Research, Inc., as a supervising project engineer. I am working out of Erin's southern California office in Laguna Niguel. I am currently providing reliability and risk management services to Southern California Edison Co., Florida Power and Light Co., and Entergy Operations, Inc." . . . **Mark F. Samek**, SM '78, is an instrumentation and controls engineering supervisor at Northeast Utilities in Berlin, Conn. . . . **Eric L. Westberg**, SM '72, reports from Irvine, Calif., that he continues as president of Hadsen Power, Inc., an independent private sector power company with 220 MW in operation and another 210 MW in construction.

Nathaniel D. Woodson, SM '65, is VP and general manager of the Energy Systems Business Unit for Westinghouse Electric Corp. in Pittsburgh. Previously, he was president of the company's International Division. . . . **Vincent P. Manno**, ScD '83, has been promoted from assistant professor to professor in the Department of Mechanical Engineering at Tufts University in Medford, Mass. . . . *Bioenergy and the Environment* (Westview Press, 1990), is a new book edited by **Janos Pasztor**, '78, and **Lars A. Kristoferson**. The book contains a series of articles that address the feasibility of the use of biomass fuels—wood, animal- and crop-wastes, alcohols—as renewable energies, along with their potential environmental impacts.

TPP TECHNOLOGY AND POLICY PROGRAM

Jean-Bernard Caen, SM '81, created his own consulting company six months ago specializing in banking executive systems and in financial risk management. Jean-Bernard and Fabienne have also announced the birth of their first child. **Timothee** arrived on July 17, 1990. . . . **Douglas Comstock**, SM '88, has relocated to Huntsville, Ala., where he is involved with the Space Transportation Infrastructure Study from pre-proposal activities, to writing the proposal and performing the study. **Doug** and **Susan Louk** got married in October 1990. . . . **Stephen Filippone**, SM '88, has been working for General Electric as a member of their management program in Acuna, Mexico. At the time of this writing he was planning a January 1991 wedding. . . . **Mike Massimino**, SM '88, recently attended the International Astronautical Federation's Conference in Dresden, Germany, where he was awarded the prestigious "Gold Medal" for his submission to the Student Paper Contest. Bravo Mike! Mike is currently in the Mechanical Engineering Department here at MIT working on his PhD thesis. . . . **Henry Elkington**, SM '88, is currently working with the Boston Consulting Group in London, England.

Dan Greenberg, SM '90, has joined the staff of the Electric Power Division at the Massachusetts Department of Public Utilities. . . . **Mark Roberts**, SM '90, has moved to Washington, D.C.,

where he will be working at the U.S. Congress Office of Technology Assessment. . . . **Isna M. Soedjatmoko**, SM '87, is now working with the Office of the State Minister for Population and the Environment. Her responsibilities include helping to set up a new environment agency for "marketing" environmental programs to international development assistance agencies. Jakarta is currently being hit by "localized global warming," (i.e., dry season). Anyone wishing to escape the cold should go to the equator, and let her know beforehand! . . . **Shinji Nambo**, SM '90, is currently working in Japan for a non-profit organization called Engineering Consulting Firms Association as a consultant assisting developing countries in terms of economic and technical cooperation. Consequently he travels for business quite often. So far, his travels have taken him to Thailand and Mexico and he is planning to go to the Philippines, Indonesia, and Malaysia.

Tatsujiro Suzuki, SM '79, has been appointed assistant program director for the new MIT International Program for Enhanced Nuclear Power Plant Safety. The program, headed by Professor **Kent F. Hansen**, ScD '59, of the Nuclear Engineering Department, is expected to last five years. At the same time, he has started working as a senior researcher for an energy/environmental consulting firm, the Washington International Energy Group. . . . **Brian Mellea**, SM '78, has just moved into product marketing at Apple where he is responsible for representing developer's hardware needs to the engineering design teams. Brian has recently spent some time in the North Cascades hiking and climbing. . . . **Christine M. Bohner**, SM '86, just completed a robot built to move glass around a clean room environment and shipped it to Japan this past January. . . . **Shashi Sharma**, SM '78, is the executive director of Tele-Talk Technologies in Pune, India. . . . **Richard Tomlinson**, SM '86, was chosen to represent Britain in the Camel Trophy, which is a rally that takes place every year in the remote parts of the world. This year it was held in Western Siberia and was a unique opportunity to see that part of the Soviet republic.—**Rene Smith** for **Richard de Neufville**, MIT, Rm. E40-252, Cambridge, MA 02139.

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Robert G. Eccles, Jr.
Frederick P. Gross
Michael John Jacobson
Debra R. Judelson
Samer S. Khanachet
Stephen P. Miller
Frederic S. Mishkin
Gregory E. Moore
Douglas B. Moran
C. Timothy Ryan
Thomas R. Stagliano

1974
James Richard Andrew
Ian Fisher
Marcel P. J. Gaudreau
Michiro Iwanaga
Steven Candido Lausell

Gary Lee Peskin
Laurence John Segil
Howard Donald Sitzler
Richard J. Sternberg
R. Gregory Turner

1975
Kenneth J. Armstead
Jeffrey M. Broughton
Stephen M. Chapman
John Dana Chisholm
Loren E. Dessonville
Robert M. Lefkowitz
Karl I. Li
Thomas F. McKim
David A. Moon
Barbara L. Moore
Frank E. Peseckis
Eric R. Rosenfeld
Donald E. Shobrys
Peter A. Simonson
Aldigras J. Skrinska
John D. Sybalsky
S. William Wang
J. David Wargo
Arlo F. Weltge

1976
Andrew S. Farber
Jeffrey J. Held
Mark E. J. Keough
Robert J. Lepkowski
Gregory S. Malkin
Thomas J. Martin, Jr.

1977
David R. Fett
Jonathan B. Green
C. Douglas Howard
Hamid R. Moghadam
Daniel A. Nolet
Gregory F. Resker

1978
Clifford J. Behmer
David B. Burstein
Brian J. Frohring
Thomas C. Janson
Steven T. Kirsch
Teresa C. Nolet
Kirk L. Reistroffer
Eric R. Shienbrood
Jonathan D. Sieber

1979
Donald J. Devine, Jr.
Paul E. Hoffman
Ellen Leckband
Barry A. Newman
Louis J. Paglia
David M. Simon
John P. Stautner
David L. Tohir

1980
Ann Marie Connor
Timothy M. Folster
John W. Larson
Howard W. Seidler
Paul E. Vianna

1981
Warren J. Dew

1982
Bruce A. Kiernan
Alison B. Kutichins

1984
Paul J. Bradford
Csaba P. Gabor
Kenneth K. O
Theodore Sylvan

1985
John J. Frishkopf
David M. Libby
Maureen A. Sybertz

1989
Tukien M. Lam

Aeronautics & Astronautics
Benjamin P. Blasingame '50
C. Robert Gates '48
Arthur Gelb '61
Vlado Lenoch '76
Rose E. Lunn '38

James S. McDonnell III '59
Charles A. Wurster '55
Architecture
Rex M. Ball '58
Bill C. Booziotis '60
Robert A. Luersen '72
Francis R. Meisch '40
Ki Suh Park '59
Linda S. Tuttle '76
Guntram Weissenberger '50

Center for Real Estate
Development
Geoffrey C. Lands '88

Chemical Engineering
David W. Bareis '47
Leonard Berkowitz '58
Nelson T. Bogart, Jr. '39
Cherry L. Emerson '41
John E. Fay II '71
Maurice F. Granville '39
James R. Katzer '70
David H. Klipstein '56
James Lago '47
Edward A. Mason '50
Guy T. McBride, Jr. '48
John E. Millard '35
George C. Putnam '36
Robert L. Richards, Jr. '51
Robert J. Richardson '54
Walter S. Smith '30
Min-Nan Sze '70
Robert S. Timminis '57
William E. Tucker, Jr. '42
Jordan T. Weills '43
Irwin S. Zonis '52

Chemistry
Elwood P. Blanchard, Jr. '59
Malcolm D. Bray '41
Ping S. Chu '80
Anthony B. Evinin '66
Gerald D. Laubach '50
Arthur S. Obermayer '56
Paula Jean Olszewski '79
Edwin P. Przybylowicz '56

Civil Engineering
Mrs. Sidney G. Albert '32
Francis Y. H. Chin '73
John F. Kennedy '76
Edward B. Kinner '70
Thomas S. Maddock '51
Brian J. Watt '70

Earth, Atmospheric &
Planetary Sciences
(includes Meteorology)
Paul L. Cloke '54
Todd M. Gates '71
Leonard W. Weis '47

Economics
Robert W. Adams '51
William Dellal '77
Stanley Fischer '69
Heather L. Ross '70
Balbir S. Sihag '78
Robert A. Taggart, Jr. '74

Electrical Engineering
& Computer Science
James S. Bell '33
Robert P. Bishop '80
Charles A. Desoer '53
Paul J. Fox '73
Michael D. Gerstenberger '85
John P. Green Jr. '61
Irwin M. Jacobs '57
Robert M. Johnson '56
A. Kusko '44
Edward F. Magnusson '48
Harry Mandil '41
Terrence P. McGarty Jr. '71
Kenneth E. McVicar '50
Alexander L. Pugh III '53
Frank C. Somers III '38
Robert J. Spinrad '63
Kenneth A. Van Bree '71

Graduate Management
Robert A. Malone '50
Scott E. Butler '81
Timothy T. Chan '75

Jonathan T. Dahl '77
Adam M. de Sola Pool '88
James E. Donaghy '58
James C. Emery '54
Fred M. Fehsenfeld, Jr. '75
Israel Feldman '58
Russell M. Frankel '71
Thomas C. Gaptis '73
Edward M. Giles '59
John C. Grant '79
Donald M. Hague '77
Leslie Cliff Hruby '73
Eileen R. Kleiman '83
Lawrence A. Krakauer '80
Joel H. Lamstein '70
Andrew D. Lawrence '85
David C. O'Brien '53
Donald H. Peters '69
James H. Selbert '66
William A. Shaffer '76
Jeffrey L. Shames '83
Charles F. Stone III '76
Theresa M. Stone '76
Robert L. Sutherland '73
Kong-Heong Tan '71
Erika Williams '78
Thomas R. Williams '54
Yoshinori Yokoyama '75
Carlos E. Zaragoza '70

Materials Science &
Engineering
H. Kent Bowen '71
Dennis J. Carney '49
William J. Harris, Jr. '48
Anders F. Henriksen '78
Min-Hsiung Tsai '72
A. Robert Wasson '78

Mathematics
John H. Doles III '69
Andrew M. Odlyzko '75
Robert E. Sacks '75
Claude E. Shannon '40
Norton Starr '64

Mechanical Engineering
Karno Barkah '56
Charles E. Carlson '72
Robert H. Davis '50
Eugene L. Foster '53
William M. Hauser '73
Charles E. Hepler '50
Pericles C. Manglis '68

Nuclear Engineering
Dale E. Crane '67

Nutrition & Food Sciences
David H. Wallace '63
Ronald C. Wornick '60

Ocean Engineering
(includes Naval Construction)
Edwin Malloy, Jr. '45

Physics
Frederick E. Barstow '38
Robert H. Boden '36
Solomon J. Buchsbaum '57
F. S. Holmes, Jr. '73
Jay T. Last '56
Norman C. Rasmussen '56

Political Science
Jesse L. White, Jr. '79

Senior Executive Program
James R. Connor '89

Sloan Fellows Program
Charles R. Adler '60
Robert S. Ames '54
Oliver C. Boileau, Jr. '64
Daniel J. Carroll, Jr. '77
John C. Davis '56
William R. De Long '60
James B. Ellis II '80
Harold J. Fitzgeorge '64
Theofanis G. Gavrilis '89
Robert B. Horton '71
Michael A. Leonard '71
Laurence S. Liebson '79
Katherine B. Magrath '76
Robert A. Malone '89
Carroll M. Martenson '54
Frank Perna, Jr. '70



The following alumni/ae and friends of the Institute contributed gifts of \$250-\$999 during Alumni/ae Fund Year 1990 (July 1, 1989 through June 30, 1990) and are recognized as MIT Great Dome Associates. The names of alumni/ae who wish to be anonymous are not shown. Questions regarding Great Dome Associates should be directed to Kristin Montemagno at (617) 253-6305.

GREAT DOME ASSOCIATES

1913

Charles L. Burdick

1916

Alexander Brest
James M. Ralston

1917

Alfred J. Ferretti
G. Hobart Stebbins

1918

Arthur S. Williams

1919

Aubrey P. Ames
Francis A. Weiskittel

1920

Henry P. Massey

1921

Edward R. Chilcott
Carole A. Clarke
Arnold R. Davis
Edward W. Haywood
M. H. Naigles
Henry C. Taintor

1922

Irving Abrams
Saul J. Copelman
Robert F. Cummings
David H. Harris
Edwin H. Koehler
Edward J. O'Connor
Karl E. Schoenherr
Eugene V. B. Van Pelt, Jr.
Morton P. Woodward

1923

Edward Battey
Horatio L. Bond
August A. Buhler
Charles T. Burke
Michael Drazen
Leander H. Poor
J. Henry Scholtz
Philip H. Vivian
Bertram E. Warren
Archibald Williams, Jr.

1924

Everett C. Atwell
Walter J. Bagby
Homer S. Davis
Gardner B. MacPherson
Anthony D. Matarese
Donald E. Moore
Victor C. Smith

1925

Gates W. Burrows
Alan W. Crowell
L. Patterson Elliott
Maurice B. Frost
Edward R. Harris
Henry B. Hibbard
Maxon H. King
Yu H. Ku
Stanley C. Lane
Arthur W. Larchar
Russell G. Meyerand
Alexander J. Rokicki
Arthur M. Sharp
Anthony G. Tsongas

1926

Robert W. Conly

William W. Farr

Alec Fisher
Martin L. Grossman
Henry W. Jones
Joseph L. Levis
Albert P. Libbey
Benjamin Margolin
Charles E. McCulloch
Charles P. McHugh
M. Bernard Morgan
Charlotte T. Phillips
Louis R. Taylor
Joel S. Tompkins
George A. West

1927

Harold J. Creedon
E. Robert de Luccia
Charles Kingsley, Jr.
Gustavo Lobo, Jr.
Leroy G. Miller
George E. Onishi
Herbert Parkinson
Samuel Pearlman
Jack B. Peters
Louis B. Peterson
Harland P. Sisk
Frank C. Staples
Robert M. Tucker
Kenneth C. Vint

1928

Charles S. Carter
George I. Chatfield
Arthur R. Elliott
Newton S. Foster
Lawrence Glassman
Albert J. Gracia
William M. Hall
Hall L. Hibbard
Edward H. Holmes
Arthur C. Josephs
Morris H. Klegerman
Ernest H. Knight
Paul J. Martini
Walter F. H. Matlage
John C. Melcher
John T. Metcalf
James S. Morse
John K. Rouleau
James E. Ure

1929

Eric A. Bianchi
Newton W. Bryant
Arnold W. Conti
William E. Creedon
William J. Fine
Alfred H. Hayes
Donald L. Hibbard
Carl C. Howard
Malcolm M. Hubbard
William H. Lerner
Joaquin J. Llano
Jonathan F. McCray
Virgil W. McDaniel
Almer F. Moore
Wade H. Shorter, Jr.
Amasa G. Smith
Arthur f. Turner
David H. Wilson
Carlton E. Wood

1930

Lawrence B. Anderson
Ralph L. Appleton
Benjamin C. Buerk
Elmer R. Burling
B. Alfred Carideo
Homer L. Davis, Jr.
Irving M. Dow

Leslie W. Engler
Myron S. Falk, Jr.
Levin W. Foster
Leonard H. Goodhue, Jr.
William J. Harris
Philetus H. Holt
Edwin M. Kingsley
Jean V. Kresser
Thomas K. McManus
Frank P. Nettleton
Richard K. Phillips
Edward M. Pritchard
Angelo M. Ricciardelli
Irvine E. Ross, Jr.
Anthony R. Savina
John J. Scheuren, Jr.
Granger D. Schrader
Harold R. Spaans
Parker H. Starratt
Lester Steffens
Olin J. Stephens II
Ernest J. Tauch
Alan W. Vint

1931

Herbert K. Allbright
Henry E. Baratta
C. Randolph Binner
Charles Broder
W. Bowman Cutter
John H. Dodge
Edwin J. Ducayet
Arthur G. Fuller
Laurence C. Hicks
William C. Kay
Albert L. Kaye
Addis E. Kocher Ret
Donald S. Loomis
F. Arthur Lutz
Charles W. Martel
George Moy
William A. Pitbladdo
Henry D. Randall, Jr.
F. David Schweizer
Albert R. Sims
H. Sheldon Smith
John R. Swanton, Jr.
Charles W. Turner
Henry B. Walker
Kenneth E. Wischmeyer

1932

William F. Bannon
Robert T. Billings
Edward F. Cahoon
Melvin Castleman
Sidney M. Edelstein
John W. Flatley

Joseph C. French
John T. Kelton
G. Robert Klein
Guy C. Lentini
Eugene F. Lynch
Charles E. McCormack
Edmund F. McLaughlin
Jacob Millman
Robert K. Mueller
Samuel G. Nordlinger
Robert C. Prescott
William H. Reid
James J. Robson
Thomas R. Smith
Charles H. Taylor
Herbert M. Wagner

1933

Morris C. Beldon
Charles E. Cashman, Jr.
George R. Churchill
George L. Cory
Warren S. Daniels
Thomas K. Fitzpatrick
Guido M. Garbarino
Arthur S. Hayden
Robert Heggie
Paul J. Pettitmermet
Frank A. Record
Stephen H. Rhodes
Richard Robinson
John R. Sloat
David B. Smith
Raymond W. Smith
I. Harry Summer
Richard H. Valentine
Warren G. Webster

1934

Walter W. Bird
John G. Borger
George G. M. Bull
Leo A. Carten
Roger T. Coffey
Kenneth L. Dorman
Lawrence C. Ebel
Joseph Fishman
Walton W. Hofmann
Robert M. Jordan
Theodore O. J. Kresser
E. Philip Kron
Ernest E. Lockhart
Douglas C. MacMillan
John J. McHugh, Jr.
William F. Milliken, Jr.
Jerry B. Minter II
Frank H. Moore, Jr.
Walter F. Read

Theodore N. Rimbach
Herbert R. Schwarz
Melvin A. Sousa
Frederick Spaney, Jr.
Malcolm S. Stevens
Bernard N. Stiller
Warren L. Towle
Philip B. Walker, Jr.
Max Winer
Walter L. Wise, Jr.

1935

John H. Anderson
Bruce R. Bagley
John B. Ballard
J. Goffe Benson
Willard F. Bixby
Lester A. Brooks
Spencer Carpenter
James E. Castle
Leo H. Dee
George C. Dunlap
Richard H. Eshbaugh
Gerhard T. Feyling
Ellis M. Flink
Robert F. Flood
Joseph L. Haggerty
Frank R. Hatch
Richard L. Hughes
Richard F. Jarrell
Jacob Leeder
Franklin F. Lovering
George N. Lykos
Robert C. Madden
Rollin D. Morse
Bernard H. Nelson
John A. Rodgers
Robert W. Spinney
Warren E. Sundstrom
Frank S. Walters
Kasmierz J. Winiarski
Edward Woll

1936

Aldo H. Bagnulo
James G. Baker
Robert J. Caldwell
Leonard B. Chandler
Edward E. Christopher
George F. Crumney
Kathleen V. Cummins
Vincent T. Estabrook
Lewis Gelbert
Martin A. Gilman
Eli A. Grossman
Anton E. Hittl
Aurelius P. Hornor, Jr.
Stanley T. Johnson
Morris Lepes
Francis H. Lessard
Walter K. MacAdam
August V. Macrock
Brockway McMillan
Harold F. Miller
John A. Myers
Roman L. Ortynsky
James F. Patterson
Lawrence G. Peterson
Frank L. Phillips
John C. Rowell
Winthrop G. Scott
Dorian Shainin
Leonard S. Stolor
G. Nelson Tower, Jr.
Henry R. Wilsey

1937

Frederick J. Altman
William O. Arnold
Frank J. Barrett
John H. Fellouris

Robert C. Glancy, Jr.
Archibald R. Graustein, Jr.
Thomas L. Hallenbeck
Daniel J. Hanlon, Jr.
Josiah S. Heal
Francis X. Maida
Leon A. Menz
Gilbert C. Mott
John B. Nugent
Thomas A. O'Brien
Philip H. Peters
Melvin A. Prohl
Harold E. Prouty
John C. Robbins, Jr.
Norman B. Robbins
Joseph A. Smedile
Robert H. Thorson
Edward F. Tibbetts
Ralph P. Webster, Jr.
Albert E. Whitcomb
Duane O. Wood
G. Richard Young

1938

Lewis H. Allen, Jr.
Franklin S. Atwater
Donald R.E. Barnaby
David W. Beaman, Jr.
Harold W. Butler
Jeanne K. Buxbaum
Abbott Byfield
Dempster Christenson
Albert M. Clogston
Russell C. Coile
John H. Craig
Robert S. Gordon
Gifford Griffin
Horace H. Homer
Roy C. Hopgood
Sumner H. Kalin
H. Bruce Leslie
Ira H. Lohman, Jr.
Dale F. Morgan
Anne S. Mowat
Enver Muradoglu
James P. Pollock
William F.H. Purcell
Isaac Schwartz
Donald P. Severance
Harold H. Strauss
Vernon C. Winn

1939

John F. Allen
Antonio Arias, Jr.
Woodson W. Baldwin, Jr.
G. William Beer
George Beesley
Peter M. Bernays
Louis S. Castleman
R. Wade Caywood
Harold Chestnut
John H. Crankshaw
C. Philip Epifano
J. Warren Evans
David S. Frankel
Donald G. Gleason
Gus M. Griffin
William E. Haible
Ralph L. Hegner
August B. Hunicker, Jr.
Ernest R. Kaswell
Burkhardt A. Kleinhofer
Lawrence M. Lyons
David E. Morgan
Morris E. Nicholson
Frederick S. Nowlan, Jr.
Charles S. Parker
Walter B. Parker
W. Hewitt Phillips
George G. Poulsen

Robert W. Pratt
Earl N. Reynolds
Paul E. Sandorff
Robert A. Schmucker, Jr.
Carl A. Segerstrom, Jr.
Samuel Sensiper
Edwin K. Smith, Jr.
Rodolfo M. Soria
Julian M. Spencer
Stuart G. Stearns
Winthrop M. Steele
Robert V. Sternberg
Robert A. Stone
Alexander M. Thackara
G. Woodford Thomas
Wallace P. Warner
Theodore A. Welton

1940

Edgar W. Adams, Jr.
James L. Baird
John A. Berges
Edgar L. Bernard
Robert J. Best
Michael E. Biancardi
Scott Brodie
Harvey H. Brown
Roy W. Brown
Clement F. Burnap
Samuel P. Card
Knight S. Carson
John J. Casey
Robert T. Church
Donald M. Cole, Jr.
Harry N. Cottle
George A. D'Henecourt, Jr.
Margaret T. Diens
Richard J. Eberle
Harry A. Ferullo
Dudley B. Follansbee
Hyman M. Freedman
Morris I. Gabel
Philip M. Garratt
Richard E. Gladstone
Robert V. Gould
William H. Hagenbuch
Robert S. Harper
T. Stewart Harris
Harold D. Hawes
Edward G. Hellier
Robert S. Hess
David B. Hoisington
Paul O. Jensen
Lawrence G. Jones
John Kapinos
Daniel S. Karp
Edith M. Kingsbury
John T. Kirk, Jr.
Wylie C. Kirkpatrick
J. Halcombe Laning
John G. Leschen
David H. Lichter
David F. Lowry
Richard E. MacPhaul
John P. McEvoy
Richard F. McKay
John M. McKee, Jr.
William W. Merrill
Louis Michelson
Robert S. Nedell
Samuel I. Omansky
Joseph F. Owens, Jr.
Richard M. Powers
Judson C. Rhode
Adolph L. Sebelle
William R. Stern
David E. Swenson
Ralph N. Thompson
M. Spalding Toon
Phelps A. Walker
Jackson E. Wignot
George M. Wolfe

1941

Zachary P. Abuza
Robert E. Bailey
Albert L. Bensusan
Robert Wilson Blake, Jr.
Roger G. Blum
George B. Boettner
William T. Butt
Ralph B. De Lano
Robert J. Demartini

Martin L. Ernst
Lewis D. Fyke
Franklin Hawkins
Rudolph W. Hensel
Lewis T. Jester, Jr.
David Josefowitz
William E. Lamar
Zhi F. Li
William E. Lifson
Robert S. Lundberg
Robert W. Mayer
Newell H. McCuen
A. Hoadley Mitchell
John B. Murdoch
Joseph S. Quill
Harold Radcliffe
Robert E. Smith
John J. Symons
Stanley A. Tirrell

1942

Arthur W. Avent
Lawrence E. Beckley
Howard W. Boise, Jr.
William A. Bolhofer
David Christison
Charles N. Cresap
Robert H. Crosby, Jr.
Luther Davis, Jr.
Howard T. Evans, Jr.
Philip E. Fox
Robert H. Given
Charles S. Hofmann
A. Paul Hotte
Herbert H. Howell
A. Carleton Jealous
Warren S. Loud
Ferdinand Lustwerk
Alan B. Macnee
Charles D. Magdick
Adrian G. Marcuse
Claude M. McCord, Jr.
Joseph R. McHugh
David B. Nicholson
Milton M. Platt
William A. Rote
Robert N. Secord
Morris A. Steinberg
Louis E. Stouse, Jr.
Maurice E. Taylor
Edward P. Todd
Peter G. Volanakis

1943

George W. Bartlett
Arthur O. Black, Jr.
Frank E. Briber, Jr.
Charles F. Chubb, Jr.
Paul R. Coulson
Ira G. Cruckshank
Charles A. Duboc
Thomas K. Dyer
David M. Falk
Richard S. Fallows
George Feick
Richard M. Feingold
Ralph R. Feuerrig
Leo A. Fitzpatrick
Gregory G. Gagarin
Ward J. Haas
James F. Hoey, Jr.
Wilfred Kaneb
Robert S. Kelso
William R. Kittredge
Bernard J. Lange, Jr.
Israel Z. Lenzner
Hung Liang
James A. Malloch
T. Kemp Maples
John M. Miller
Thomas A. Mitchell, Jr.
Harry Ottinger, Jr.
Hugh Parker
Don H. Ross

William L. Sammons
William A. Selke
Sidney Siegel
Morton F. Spears
John C. Stetson
Herbert G. Twaddle
William A. Verrochi
Hans G. Walz
Thomas W. Winstead
Michael Witunski

1944

Edgar C. Ahlberg
Mario D. Banus
Ralph A. Barrows
Norman Beecher
Robert E. Benedict
Richard S. Bettes, Jr.
Henry N. Bowes
John H. Burdakin
Herbert L. Carpenter, Jr.
John Chamberlain
Andrew Chaplin
Frank K. Chin
Andrew F. Corry
Louis R. Demarkles
Gonzalo C. Docal
Laurence E. Dowd
R. Dean Dragsdorf
Bernard J. Duffy, Jr.
Lee C. Eagleton
John Flanigan
John G. Floden
Weston W. Goodnow
Arthur Gray, Jr.
Sten Hammarstrom
Herman J. Harjes
Holton E. Harris
Harold B. Higgins
David M. Himmelsblau
Richard H. Hinchcliff
Robert V. Horrigan
Warren H. Howard
Austin T. Hunt, Jr.
Walter A. Jaeger
Martin King
Herbert F. Knappe
Jay M. Kogan
Samuel H. Lampport
Han Tang Liu
Robert D. Maher
Kenneth W. Nelson
Edmund W. Peakes
E. Alfred Picardi
C. Spencer Powell
William S. Richardson
Paul M. Robinson, Jr.
George S. Saulnier
Andrew J. Schmitz, Jr.
Norman I. Sebelle
Leland F. Stanley
Hugh M. Taft
Robert V. Thiede
Page S. Ufford, Jr.
John Upton, Jr.
John Woolston
William A. Wynot
Aaron Zicherman

1945

John O. Atwood
James M. Barrabee
Walter E. Borden III
George R. Brothers, Jr.
David P. Flood
Reynold A. Grammer, Jr.
James S. Hardigg
William L. Hatton
Sing Leong
Robert N. Magliathin
Andrew A. Marocchi
Thomas J. McNamara
Arthur E. Miller
Nicholas V.S. Mumford, Jr.
William H. Pasfield
Philip J. Pocock
David O. Richards
Eugene S. Rubin
Max E. Ruehrmund, Jr.
Luigi J. Russo
Robert K. Schumacher
Clinton H. Springer
Edward Stoltz, Jr.
James J. Strnad
Harold Thorkilsen
Daniel R. Vershbow

1946

Richard M. Adler
Louis B. Barber
Edward L. Belcher
Raymond E. Benenson
L. G. Body
Sterling S. Bushnell
Daniel I. Cooper

Hillman Dickinson
Thomas J. Donnelly
Stanley T. Droski
John S. Filbert, Jr.
James A. Finney, Jr.
Robert K. French
Walter C. Gloekler, Jr.
A. E. Halberstadt, Jr.
Robert F. Hoffman
Ernest G. Jaworski
Mason I. Lappin
Gilbert Marr
Alexander W. McEwan
James S. Murphy
Barbara R. Murray
Robert W. Neal
James C. Ray
Frederick J. Ross
Marvin Sparrow
Richard J. Steele
John F. Sullivan
John W. Taylor, Jr.
Edwin H. Tebbetts
Warren H. Turner
Juan B. Vicini
Louis B. Wadel

1947

R. F. Athow
Thomas H. Bay
S. Lewis Bernheim
Peter Callejas
Daniel J. Carnese
William J. Crawford III
Steffen F. Dieckmann
Walter R. Ericsson
Wilfred L. Freyberger
Virginia I.C. Grammer
James E. Haggett
Jacques A.F. Hill
John G. Holmes
Charles W. Hoover, Jr.
Arnold S. Judson
Walter P. Kern
Edward C. Kistner, Jr.
Kenneth A. Marshall
John C. Martin
John E. Maxfield
Thomas McEvoy, Jr.
John J. Murphy
Gilbert S. Parker
Alexis Pastuhov
Norton T. Pierce
Peter P. Poulos
Willis B. Reals
Joseph J. Riley
Jack W. Rizika
Pavle Sancer Santich
Richard A. Scheuing
Paul K. Schilling
Arthur Schwartz
Martin D. Schwartz
Irving L. Schwarz
Carol Tucker Seward
Harry Sherman, Jr.
William R. Smith-Vaniz
Marvin W. Sweeney, Jr.
Ferdinand S. Veith
Howard A. Zwemer

1948

Stanley Abkowitz
S. James Adelstein
Eugene Ashley
Fred C. Bailey
Marshall E. Baker
William Bangser, Jr.
Jack Baring
Richard V. Baum
Richard C.B. Berry
S. Martin Billett
Carl Blake
Barry M. Bloom
Joseph J. Bongiovanni
Paul A. Buckingham
Thomas J. Cahill
Leo Celniker
Cassius M. Clay
Richard J. Conlan, Jr.
Robert C. Dean, Jr.
Bernard P. Devins
Nicholas De Wolf
George S. Dundon
Edward P. Farnsworth

Guido J. Frassinelli
John L. French
Robert S. Friedman
Edward S. Frohling
Alden F. Greenlaw
Peter A. Guercio
Robert W. Hanpeter
Geraldine M. Haughey
John W. Hawkins
Edwin E. Hebb, Jr.
Frank W. Heilenday
E. Neil Helmers
John C. Henderson
Robert O. Hirsch
F. W. Horstkotte, Jr.
William N. Hosley
Howard A. Jacobson
Donald Jenkins, Jr.
Robert H. Jenkins
William J. Joyce
William E. Katz
Harry L. Kopp
Louis F. Kreek, Jr.
Philip M. Lally
James P. Landis
Irwin L. Lebow
James Leon
Franklin E. Mange
James E. Manson
Raymond E. Maritz, Jr.
Bonni P. Martinez
Manuel L. Matnick
John C. Moore
John J. Moran
Roland L. Nagy
John E. Nicholson
Donald W. Noble
Julian F. Pathe
Donald M. Perkins
Gordon H. Pettengill
William R. Porter
Frederic M. Richards
Hernan Rocha Garza
Gilbert V. Rohleder
J. Norman Rossen
Jay S. Salz
Robert L. Sandman
William B. Schmidt
George E. Sherman
Mark L. Sherman
Robert H. Shoulberg
Arnold M. Singer
Arnold H. Smith
James T. Smith
Earl K. Solenberger
Glenn W. Stagg
Charles M. Tenney, Jr.
John M.D. Walch
Henry Warner
Harvey B. Willard
Backman Wong
Haig S. Yardumian
Norman S. Zimbel

1949

Ira R. Abbott, Jr.
John R.M. Alger
Richard F. Amon
Robert A. Arrison, Jr.
John W. Barriger IV
Orlien N. Becker
Paul S. Berrow
Robert O. Bigelow
William R. Bohlman
Frederick I. Brown, Jr.
Bruce Campbell
Norman A. Chrisman, Jr.
James W. Christopher
Leslie W. Cline, Jr.
Gary S. Colton
Richard A. Cousins
Thomas J. Devine
Henry B. Dickenson
John R. Doyle
John Fairfield, Jr.
H. Federhen IV
Guilford W. Forbes
William A. Forsyth, Jr.
John W. Goppelt
A. Neale Gordon
Harold G. Green
Daniel W. Greenbaum
Robert W. Grott

Dwight H. Hibbard
Charles K. Holmes, Jr.
Arthur M. Howarth
Sidney C. Howell
Harold G. Ingraham, Jr.
David B. Kellom
Edward M. Kerwin, Jr.
Otto E. Kirchner, Jr.
John W. Knowlton, Jr.
Malcolm H. Kurth
Richard E. Lang
Ray E. Larson
Ingram Lee II
Raymond A. Lindstedt
Arthur C. Loven
William J. Luckell, Jr.
John Mehta
Gregor F. Meyer
Paul G. Miller
Richard D. Morel
Paul B. Ostergaard
Albert T. Owens
Jan B. Peyrot
Andrew R. Pfeifferberger
A. Stuart Powell, Jr.
Kenneth M. Prytherch
Kjell Rinde
Lewis H. Roosa
John R. Saxe
William C. Schneider
Richard J. Scully
Nathan O. Sokal
Richard W. Spencer
Bernard D. Steinberg
Edward T. Thompson
J. Thomas Toohy
James Veras
Charles M. Walker
Yenwith K. Whitney
Eugene E. Woodward
E. H. Zapata
Marvin D. Zimmerman

1950

W. Leslie Allison
Richard F. Armknecht, Jr.
Walter S. Attridge, Jr.
Alan D. Baird
George A. Basta, Jr.
Alan G. Bates
Guy C. Bell, Jr.
Herbert D. Benington
James J. Bennett
Lowell S. Bensky
Anne C. Bickford
John H. Bickford
Howard P. Bill
Donald C. Bishop
Beynon Blanchard
Ralph W. Booker
Sterling G. Brisbin
Clinton D. Burdick
William L. Carey
Warren F. Clement
Edward S. Cohen
Henderson Cole
Richard E. Dobroth
Jack E. Downhill
Allyn W. Eade
A. John Esserian
Kenneth Fertig
James M. Fitzpatrick, Jr.
Daniel E. Flanders
Harry G. Foden
Melvin J. Gardner
Rowland M. Garratt
Sebastian J. Gianni
Richard A. Gnecco
Thomas N.K. Godfrey
James F. Goff
Robert F. Gordon
Joseph S. Gottlieb
Roger K. Graham
Frederic D. Grant
Donald J. Gray
Robert A. Haass
Donald A. Harnsberger
Emile F. Harp
Edward J. Hayes
Francis X. Hogan
Samuel S. Holland, Jr.
Jack J. Jackson
James T. Jensen

Carroll I. Johnson
Reginald A. Krystyniak
John S. Lane
Harry R. La Towsky, Jr.
John B. Lawson
Gerald A. Lessells
Andrew T. Ling
Paul A. Lobo
James M. Lydon
John H. MacMillan
Claus G. Manasse
Stanley Martin, Jr.
Gordon I. McBain
Daniel L. McGuinness, Jr.
John T. McKenna
Raymond M. Moeller
Garvin M. Moore, Jr.
Clifford C. Morton
William Murphy, Jr.
John J. Paull, Jr.
Paul F. Pearce
William S. Peppier, Jr.
Richard R. Potts
Albert Rand
Milton L. Rand
Sam Raymond
John T. Reeves
Herbert A. Ridgway
Elliot Ring
Mariano A. Romaguera
Richard G. Rorschach
Kenneth A. Sawyer
Albert V. Shortell, Jr.
John A. Smith
Robert P. Smith, Jr.
Robert A. Snedeker
Richard A. Stephan
Edward R. Stover
Dan R. Test
Norman F. Tisdale, Jr.
Constantine T. Tsitsera
James R. Ullom
Anthony Vinciguerra
Paul B. West
Lars Erik Wiberg
Robert E. Wilson
Robert W. Wright
Louis Young

1951

Manfred E. Becker
John H. Bergmann
Christian C. Bolta
William J. Cavanaugh
Charles A. Compton
Donald K. Crockett
Robert A. Cushman
John F. Dennis
George L. Downie
Jerome I. Elkind
Charles W. Ellis III
Allan Elston
Frederick D. Ezekiel
Richard R. Fidler
David Findlay
Marvin H. Frank
Harold S. Glenzel
Madge Goldman
Avrom R. Handleman
Parker W. Hirtle
Lawrence W. Hitchens
Albert E. Hughes
Rodney G. Huppi
Joseph Iannicelli
Henry R. Jex
Morley D. Kahn
Karl Kniel
J. Franklin Koehler
L. Keith Koehler
Robert W. Kress
Robert A. Lindquist
John C. Lowry
Robert L. MacCallum, Jr.
Daniel J. MacCormack
Henry N. Marsh, Jr.
William R. Miller
William F. Moon
Milton R. Neuman
Charles A. Orne, Jr.
James A. Pitcock
Lester W. Preston, Jr.
William G. Rhoads
Bernard Rothzeld

- Laurence L. Rubin
Samuel Rubinovitz
Roy M. Sachs
Winfield O. Salter
Joseph B. Sangiolo
Herbert I. Scher
George E. Schultz
Joseph N. Sherrill, Jr.
Harold Aryai Siegel
Lester M. Slocum, Jr.
Paul G. Smith
David M. Spaulding
Anthony Stathopoulos
Louis G. Sylvia, Jr.
John J. Welch, Jr.
Bernard Widrow
I. Victor Yancey
- 1952**
Alvin H. Andrus
Arthur I. Auer
Charles G. Beaudette
John C. Berlinguet, Jr.
John C. Casson
Allan Chin
Bock M. Chin
Robert W. Danforth
Milton S. Dietz
James Dorsey
Frank B. Fairbanks
Howard H. Fawcett
Daniel E. Finger
Alan S. Geisler
Herbert Glantz
Jack H. Guthrie
Nicholas J. Haritatos
Richard E. Heitman
Clifford H. Heselton
Arthur F. Howard
Paul R. Johannessen
Harry S. Kradjian
Arnold G. Kramer
Richard F. Lacey
William H. Lane
Jack Larks
Herbert C. Lebovitz
Michael D. Mintz
Daniel H. Lufkin
Robert M. Lurie
Paul A. Lux
James M. Margolis
Edward J. Margulies
Edward K. Matthews
Michael Nacey
Kevork V. Nahabedian
Robert H. Norton
Eng Hung Ong
Ralph E. Raynard, Jr.
Edward A. Ryan
John B. Savoca
Clifford M. Sayre, Jr.
Stanley J. Solomon
H. Stephen Spaul
James I. Stockwell
James S. Stolley
James R. Strawn
Donald F. Tarinelli
Emil J. Volcheck, Jr.
Seymour S. Weintraub
Andreas Wessel
- 1953**
Sydney E. Abend
Ralph D. Anglin
Joseph B. Banks
David M. Berg
E. Fred Brecher
Charles D. Buntschuh
John R. Ehrenfeld
Jesse D. Erickson
Norman C. Ford, Jr.
Morton J. Friedenthal
Albert W. Hecht, Jr.
George B. Hegeman
John F. Horning
Charles R. Johansson
Lionel L. Kinney
David L. Klepper
Gerard P. Langelier
Richard I. Linde
Richard S. Lindstrom
W. James Mast
Robert P. McDonald
John P. Medgyesy
- Douglas L. Meyer
Joan F. Mizer
William S. Nagel
L. N. Odenice
Herbert M. Oestreich
Robert R. Piper
John G. Polk
Burton M. Rothleder
Stanley J. Sadowski
Frank D. Skinner
Willard B. Spring
G. Harold Tseklenis
Jon Van Winkle
- 1954**
Gordon Aitken
Robert E. Anslow
Peter Bishop
Barbara B. Black
John Blair
Michael B. Boylan
James W. Brown, Jr.
Donald L. Cassidy
Jerome Catz
Phil Chandler, Jr.
John S. Clauss, Jr.
Jerome B. Dixon
Donald M. Cohn
William J. Eccles
Inaki I. Elguetabal
Wilbur P. Fiske
Philip Gilbert
John H. Gusmer
Alan S. Geisler
Herbert Glantz
Jack H. Guthrie
Nicholas J. Haritatos
Richard E. Heitman
Clifford H. Heselton
Arthur F. Howard
Paul R. Johannessen
Harry S. Kradjian
Arnold G. Kramer
Richard F. Lacey
William H. Lane
Jack Larks
Herbert C. Lebovitz
Michael D. Mintz
Daniel H. Lufkin
Robert M. Lurie
Paul A. Lux
James M. Margolis
Edward J. Margulies
Edward K. Matthews
Michael Nacey
Kevork V. Nahabedian
Robert H. Norton
Eng Hung Ong
Ralph E. Raynard, Jr.
Edward A. Ryan
John B. Savoca
Clifford M. Sayre, Jr.
Stanley J. Solomon
H. Stephen Spaul
James I. Stockwell
James S. Stolley
James R. Strawn
Donald F. Tarinelli
Emil J. Volcheck, Jr.
Seymour S. Weintraub
Andreas Wessel
- 1955**
Paul H. Attridge
John W. Blake
Robert F. Buntschuh
Gordon J. Burrer
Edwin A. Chandross
Zaven A. Dadekian
Gilbert Davidson
William T. Deibel
Robert G. Dettmer
Robert G. Dunn
James H. Eacker
Philip N. Eisner
Eduardo L. Elizondo
Jesse D. Erickson
Norman C. Ford, Jr.
Morton J. Friedenthal
Albert W. Hecht, Jr.
George B. Hegeman
John F. Horning
Charles R. Johansson
Lionel L. Kinney
David L. Klepper
Gerard P. Langelier
Richard I. Linde
Richard S. Lindstrom
W. James Mast
Robert P. McDonald
John P. Medgyesy
- 1956**
Mohammad M. Akhavein
Herbert S. Amster
Victor J. Bauer
Howard S. Bertan
Bernardo Blaschitz
Bruce B. Bredehoft
Arnold P. Breeden
Warren G. Briggs
Paul E. Brown
John A. Buell, Jr.
Richard N. Carlson
Paul S. Cianci
Ronald C. Clark
Stephen N. Cohen
Kreon L. Cyros
Charles W. Dietrich
Walter J. Farrell, Jr.
Arthur Frank
Samuel S. Friedman
Larry R. Goldberg
Kenneth E. Hickman
Charles P. Hoult
Richard I. Johnson
Evan T. Jones
Gordon Kane
David L. Kaufman
Robert L. Kissner
Charles L. Kusik
Merlin E. Lickhalter
Ronald J. Massa
Robert B. Meeker
Eugene Merfeld
John H. Merkl
Clifford K. Monzeglio
Richard E. Norwood
Anthony Praznik
Jesse Rothstein
John A. Seeger
Lester John Senechal, Jr.
Walter R. Sooy
Lindley S. Squires
John D. Stelling
James O. Thurlow
Paul Hermann L. Walter
Joseph L. Wauters, Jr.
Stanley T. Wray, Jr.
Reverdy E. Wright
- 1957**
Paul R. Ammann
Richard L. Baird
Laurence B. Berger
Arthur E. Bergles
Bruce Blanchard
Richard W.H. Bohlen
Richard D. Brandes
Joseph J. Carty, Jr.
John T. Christian
Howard L. Cohen
Bernard R. Cooper
John B. Crews
Robert B. Dirks
Alan D. Donaldson
Vincent L. Donlan
William H. Doughty
Richard W. Douglass
Thomas J. Dwyer
Ronald E. Enstrom
Edward A. Friedman
Samuel J. Gerstenfeld
Boyd E. Givan
Robert W. Gray III
Eugene L. Hartman
Steven H. Hawkins
Robert P. Holton
- Edgar D. Pulsifer
Charles S. Robertson, Jr.
Randall S. Robinson
Walter Rubin
Walter G. Shifrin
Marianna P. Slocum
James A. Stone
John R. Stopfel
Harold A. Stubing, Jr.
Allen G. Tarbox, Jr.
R. Peter Tooby
Victor M. Tyler II
Philip A. Untersee
Allen H. Wahlberg
John F. Wing
Jerrold Zindler
A. Lee Zuker
- Frederick L. Jaggi
Malcolm M. Jones
Ronald W. Keefe
Deane H. Kihara
Robert M. Kline
Joseph P. Kobus
W. Hugo Liepmann
Fuhsi T. Ling
S. William Linko, Jr.
Graham Lusk
Donald C. MacLellan
Richard M. McCabe
Terrence K. McMahon
Richard R. Monsen
Frank E. Murphy, Jr.
Ross W. Newsome, Jr.
Donald A. Norman
Silvester Pomponi
Ralph C. Reynolds
Edward B. Roberts
Jared J. Safirstein
Henry E. Salzhauser
William H. Schoendorf
Herbert F. Schwartz
James G. Simmonds
Ira Skalet
Richard Stern
Lavette C. Teague
Lyle W. Torrey, Jr.
William R. Walsh
Ralph J. Warburton
Roger L. Yaseen
- 1958**
Arnold E. Amstutz
Roger D. Baggenstoss
James G. Barber
David A. Berg
Cole Bess
Thomas E. Blood
Michael E. Brose
Joseph T. Burval
Stephen Corman
Sheldon W. Dean, Jr.
R. Stephen DeVito
John F. Fallon
Richard A. Finn
Ernest R.A. Flemig
Willard E. Fraize
O. Michael Gordon
William R. Hauke, Jr.
Daniel J. Holland
Richard H. Hough
Dana Huestis
John C. Ingraham
Alan T. Johnson
Robert D. Jones
Lawrence S. Kalden
Charles R. Kuehner
Kenneth H. Langley
Paul R. Larson
King M. Lee
Hugh J. Murphy
Martin J. O'Donnell
Robert E. Oleksiak
F. W. Ostermayer, Jr.
Allen R. Philippe
Robert A. Phinney
Theodore M. Quist
David J. Rachofsky
Robert M. Rose
Paul H. Rothschild
George A. Russell
Howard C. Salwen
John M. Seavey
Louis B. Seigle
Merrill Sidman
Matthew F. Smith
Steven R. Tannenbaum
Edward Wanger
Howard G. Ziff
Bazil R. Zingali
- Edward W. Cheatham
Gilbert Y. Chin
John D. Christie
Louis Cohen
H. Roberts Coward
Dwight B. Crane
Gary L. Falkenstein
H. Jan Heesepink
Robert E. Hillman
G. Richard Huguenin
Edward J. Humann
Frank L. Hunsicker
Michael D. Intriligator
Herbert P. Kempe
Frank S. Koppelman
Kent Kresa
Myer P. Kutz
Wilbur S. Latimer
Stanley L. Levine
Bernard S. Levy
Thomas B. Lovejoy
William M. Marcus
John K. Mitchell
James P. Moran
Oscar L. Morgenstern
Stewart R. Mott
Donald E. Murray
Robin R. Oder
David F. Pawliger
Leander F. Pease III
Adul Pinsuvana
Carl H.G. Poedtker, Jr.
Robert L. Rosenfeld
Oliver E. Seikel
Louis P. Sileo
A. F. Spilhaus, Jr.
J. Richard Swenson
Lynn R. Sykes
William J. Towle
Daniel I. Wang
Paul F. Wehrauch
Jonathan B. Weisbuch
Stephen K. Whittemore
Marie M. Wray
- 1960**
Ronald D. Agronin
Paul F. Berg
Richard J. Bertman
Ronald M. Burde
E. Patrick Coady
John H. Connell
Charles R. Cushing
Charles J. Garbarini
David H. Geisler
Gary L. Gibson
Joseph I. Goldstein
Stanley H. Goodwin
Kenneth E. Hagen
Stephen E. Halprin
Charles H. Haspel
Paul H. Heller
Joel Hirschel
Fred E. Holubow
Gerald J. Hornik
George P. Koo
Morris J. Kriger
Andrew Larsen, Jr.
Robert E. Lienhard
Roger G. Mark
Larry R. Martin
Charles E. McCallum
Edward O. McCartney
Kenneth T. McKie
Harry C. Nottebart, Jr.
Richard H. Oeler
Igor Paul
Barry D. Rein
William M. Robertson
M. Elizabeth Schumacker
William C.L. Shih
S. Christian Simonson III
Warren Van Genderen
Leonard B. Vaughn
Raymond G. Wilkins
Christopher P. Witze
- 1961**
Robin L. Anderson
Peter R. Bankson
John W. Baxter
Gary W. Bickel
John Bousman
Mitchell B. Brodtkin
- Richard D. Cummings
Joseph T. Davis
Robert J. Dulsky
Dorsey C. Dunn
W. Mills Dyer, Jr.
Donald D. Easson
Reed H. Freeman
Gary L. Fultz
Thomas L. Geers
George W. Gladfelter
Edward J.J. Grabowski
Erleand H. Graf
Peter R. Gray
William C. Grimmer
Arturo J. Gutierrez
Ted J. Hammack
Grady W. Harris
George C. Harrison III
Thomas N. Hastings
Edward J. Hessler
Leo B. Hieblinger, Jr.
Lawrence A. Horowitz
Robert S. Kaplan
Carl A. Karrfalt
Jerome M. Kaufman
Wilson D. Kendall
Daniel W. Kennedy
John N. Kogan
John G. Layter
Harvey L. Lynch
Dan R. McConnell
Donald G. Morrison
Thomas P. Nosek
Michael J. O'Neill
Richard F. Otte
Leslie C. Patron
Gerald E. Pollon
Richard J. Resch
David A. Roberts
Philip J. Robinson
Charles L. Ruttenberg
Mannie Smith
Nelson E. Stefany
Edward H. Strachan
John J. Sullivan
C. Bruce Tarter
Robert B. Telfer
Peter Ver Planck
John A. Vleck
Michael J. Wechsler
Robert F. Weimer
Ronald D. Wendland
Samuel J. Williamson
- 1962**
Jeremy E. Alperin
Robert E. Anderson
Lloyd Armstrong, Jr.
Alfred H. Bellows
Grant A. Beske
William D. Bloebaum, Jr.
Peter Brown
W. Thomas Brydges III
Michael J. Callahan
V. A. Caravito
Walter L. Colby III
Arthur R. Cooke
Philip D. Cunningham
Neil Doppelt
George S. Dotson
James R. Dressler
Dean E. Eastman
Edward A. Feustel
Donald C. Fraser
William J. Fry
Jeremy R. Goldberg
Theodore C. Goldsmith
Gerald L. Gottlieb
Thomas J. Greytak
Ben B. Gunter, Jr.
Dennis R. Hafemann
Rurik B. Halaby
Russell B. Ham
Richard G. Helmig
Jon M. Heuss
Richard L. Horttor
Sang-Hak Hwang
Devrie Intriligator
Randall H. Kunz
John C. Kurkjian
Robert A. Lytle, Jr.
Modesto A. Maidique
- James D. Miller
Keihachiro Moriyasu
Robert A. Morris
Robert F. Morse
Charles M. Myers
Martin C. Poppe, Jr.
John E. Prussing
Chester H. Riley
Stephen C. Root
Darold W. Rorabacher
Allen H. Sayer
Peter R. Shrier
Steven J. Smith
David S. Stare
H. David Stein
Gary M. Stuart
Roger J. Sullivan
Richard N. Sutton
Robert L. Thews
Daniel E. Thornhill
Ronald R. Troutman
Melynn B. Weiss
- 1963**
Paul D. Abramson, Jr.
Thomas R. Anderson
Walter H. Berninger
Michael C. Bertin
Glen E. Books
Woods Bowman
Dean W. Boyd
Stephen B. Bram
Allen V. Clark
Frederick E. Cunningham
Laurence E. Demick
Steven R. Ditmeyer
Bruce A. Eisenstein
James E. Evans
John K. Flicker
Frank Y. Fradin
Anthony W. Geisler
Russell J. Gersham
Keith D. Gilbert
Thomas A. Goddard
James M. Harris
Marley B. Herrin
Richard P. Hervey
Stephen D. Hester
James W. Holcroft
William A. Jessiman
Donald K. Joseph
David F. Juncker
Kenneth M. Klein
John J. Lamberti, Jr.
James H. Latimer II
Alan T. Marty
Robert H. Maskrey
Robert M. Mason
Thomas A. Massaro
Ronald W. Matlin
John H. Meyn
Dale E. Miller
Peter M. Mlynaryk
Frank S. Model
Robert H. Morse
Ruth R. Nelson
Alan O. Ramo
Daniel R. Ross
Michael J. Schaffer
Joel E. Schindall
Charles W. Selvidge
Patricia C. Sherman
Raphael Soifer
Gene D. Sprouse
Garrett Stone
James Y. Tang
Louis S. Thompson
Robert E. Turtz
John B. Tytus IV
Frank O. Verlot
Roger N. Wallace
Ronald A. Walter
Robert A. Warman
Anthony M. Weikel
Richard N. Weiner
Patricia A. White
William J. Wolf, Jr.
Boh K. Yap
- 1964**
John C. Adamchak
Julian R. Adams
Walter M. Anderson, Jr.

F. Michael Armstrong
Alexis T. Bell
Joseph E. Boling
Leslie M. Boring, Jr.
Wayne F. B'ells
Gary R. Brooks
Truman R. Brown
John L. Chiappetta
Paul Clermont
Robert B. Colvin
Peter D. Cook
Louis A. Davidson
Norman D. Davis
Claude S. Dean
John P. Downie
John G. Endriz
Robert L. Fischer
Richard S. Fisher
James W. Giffin
Monte M. Giles
Steven J. Glassman
John N. Hanson
Anthony J. Heatwole
Jeffrey D. Heller
Robert H. Hobbs
Douglas J. Hoylman
Roger L. Hybels
Steven N. Iverson
Robert M. Johnston
Mark Joseph
Phillip S. Kilpatrick II
Bruce S. Knobe
Lowell E. Kopp
James J. Kotanchik
Richard R. Kurth
Donald S. Levy
Roger K. Lewis
Richard G. Lipes
Carl L. Mampaey
William B. McClure
Serafin Menendez
Donald J. Mided
Stephen B. Miller
Michael J. Monsler
John T. Moter
Lita Donnelly Neisen
William A. Nelson, Jr.
Herbert O. Norton
Kenneth J. Olshansky
David R. Patterson
Robert P. Popadic
Richard D. Posner
John M. Rainier
Emma Root
Robert L. Rothman
David N. Saul
Bruce P. Strauss
Jay M. Tenenbaum
Viguen R. Ter-Minassian
J. William Weber
Henry B. Weil

1965

Arnold R. Abrams
Richard A. Bator
John F. Beckmann
Dennis P. Bekeny
Paul N. Blumberg
William H. Bohlke
Peter F. Brown
Stanley A. Brown
Edward A. Bucher
Pradip C. Burman
Kenneth S. Cairns
James J. Chang
Ralph J. Cicerone
Mary E. Coffey
Stephen C. Dangel
Stephen B. Deutsch
James G. Downward IV
J. Stephen Duerr
L. Scot Duncan
Michael Edesess
Sidney J. Everett
Marshall L. Fisher
Jeffrey L. Forman
William T. Freed
Peter G. Gerstberger
Charles L. Gholz
Robert P. Goldberg
Lewis J. Green
Thomas M. Hedberg
Edward P. Hoffer

Thomas L. Jernick, Jr.
William N. Kavesch
Fred R. Kern, Jr.
Lionel C. Kimerling
Louis A. Kleiman
Peter R. Kornafel
Alan C. Leslie
Henry A. Lichstein
Steven B. Lipner
David B. Liroff
Richard H. Long
David A. Manalan
Joseph A. Mangano
H. Cannon Mathews
George C. McCurry
Frank J. Mechura
Maury K. Moore, Jr.
William H. Mooseker
Robert B. Morgan
Herbert W. Mower
Kayson Nyi
James T. Pepe
James M. Piepmeier
William J. Podolsky
Charles S. Rall
Alan L. Renninger
Sharon C. Ross
Richard L. Schmalensee
Charles D. Seniawski
Roland A. Sowards
Donald L. Shulman
Richard S. Shultz, Jr.
Philip E. Strause
Richard W. Sullivan
Bruce D. Sunstein
Robert T. Szpila
John B. Torres, Jr.
Richard W. Tsien
Robert L. Waymost
Barry D. Wessler
Joel Westernman
Jarrod W. Wilcox
Stephen L. Williams
William N. Worden
Edward Yourdon
David L. Yuille
Bruce C. Zotter

1966

James H. Batchelder IV
Paul A. Branstad
Joseph S. Bravman
William J. Briggs
W. Sumner Brown
William L. Bunce
William O. Cain
Thomas A. Casey, Jr.
Michael W. Casseday
Richard A. Clark
Richard T. Cockrill
Peter M. Cukor
Ralph M. Davison
James C. Deckert
William P. Dietrich
Steven H. Disman
Tomme W. Ellis
Charles E. Fallen
Bert E. Forbes
John K. Freeman II
Lewis H. Gaines
A. Mark Glickstein
Paul G. Godfrey
James T. Gordon, Jr.
Kenton A. Griffin
Stephen M. Hoffman
Jonathan W. Hopkins
Thomas H. Hutzelman
Robert R. Jackson
Philip M. Jacobs
Hans C. Juvkam-Wold
Paul L. Kebabian
Kenneth J. Kepchar
Henry D. Kerr III
Martin Krone
James P. Lavine
Michael R. Leavitt
Gerald B. Lichtenberger
Harry C. Moser
Henry H. Perritt, Jr.
Enrico C.L. Poggio
Thomas A. Rice
Michael D. Rinaldi
Ralph G. Schmitt

Mark S. Schwartz
Barry P. Skeist
Joseph I. Smullin
Frank E. Surma, Jr.
John H. Hella
Howard A. Van Vleck, Jr.
Ronald W. Ward
Robert A. Wells, Jr.
Edward C. Wert
Robert S. Zucker

1967

John Acevedo
Platte T. Amstutz III
Donald A. Belfer
Victor M. Bermudez, Jr.
Allen L. Brown, Jr.
Paul J. Caragine
William L. Caton III
Terry L. Collins
John W. Cook
Bradford P. Cross
John M. Davis
Cheryl A. Dawson
Matthew G. Degnen
Peter R. Denton
Gordon J. De Witte
Peter N. DiGiovanni
M. William Dix, Jr.
D. Travis Engen
Kenneth G. Follansbee
Barbara A. Gilchrist
Mark R. Goldman
Howard J. Greenbaum
Lawrence C. Hall
Edson C. Hendricks
Robert C. Hewitt
Eric C. Johnson
Martin S. Kohn
Charles E. Kolb, Jr.
R. Mike Kruger
Alan E. Kruse
Arthur C. Kwok
Andrew C. Lerner
Eric K. Li
Donald A. Mattes
David McClain
Douglas L. McCraith
Richard W. Munkelwitz
Victor Myev
Donald R. Oestreicher
Lin Olsen
Stuart H. Orkin
Robert L. Post, Jr.
Stephen J. Rawlinson
Stanley M. Rose
Chet Sandberg
John M. Shufelt, Jr.
Gerald B. Siegel
J. Edward Snyder III
Maurice H. Stauffer, Jr.
Neil Steinmetz
James A. Swanson
Kimball D. Thurston, Jr.
James C. Tsang
Bruce A. Twickler
Eugene L. Venturini
Glenn A. Wanek
Barry C. Watkins
Jeffrey M. Wiesen
Ellen Williams
John D. Wrigley, Jr.

1969

Phillip T. Balazs
William P. Bengen
J. Gerson Bloch
Rolf Brauchler
David A. Brookfield
Paul D. Brophy
Charles W. Buzenli, Jr.
David A. Cane
Gary B. Carpenter
Marc Davis
Michael S. Devorkin
David L. Dewitte
Gary C. Dixon
Robert H. Dobson
Bruce R. Donath
Mark Drazen
Michael J. Epstein
Paul D. Evans
Gary A. Ford
Matthew M. Frackiewicz
Jeffrey H. Grotte
Bruce K. Hamilton
Bruce L. Heflinger
Stephen A. Hill
John M. Hirsch
Richard B. Hodgman, Jr.
Joseph A. Horton
Alan C. Huber
Kathryn K. James
John F. Kaar
David P. Kelleher
Thomas H. Kick
Morris Kinast
Richard Kremendorf
Carl W. Kuhnien, Jr.
Michael W. Laird
Ronald W.J. Lau
Mark B. Lively
John I. Loewenstein
David L. Lyon
Richard G. Marcus
Robert G. McGregor
Geraldine G. Miller
Dean S. Musgrave
L. Robert Pokorny
Roy F. Quick, Jr.

1968

Harvey Allen
Robert B. Anthonyson
David E. Bainsum
Paul F. Bente III
Donald R. Bruns
Ronald P. Burd
William E. Carlson
John J. Cleary, Jr.
Samuel A. Cohen
Arthur E. Cole, Jr.
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Nicholas J. Covatta, Jr.
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Vahe Davidkhanian
Steven E. Denieroff
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Charles L. Dorian
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Daniel M. Green
Peter Groot
Daniel G. Gruber
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Robert C. Hendel
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Kenneth I. Rosenberg
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Leonard H. Schrank
Andrew Seidenfeld
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Kenneth P. Wacks
Randall Warniers
W. Stephen Wilson
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John F. Kaar
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Thomas H. Kick
Morris Kinast
Richard Kremendorf
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Michael W. Laird
Ronald W.J. Lau
Mark B. Lively
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David L. Lyon
Richard G. Marcus
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O. Reid Ashe, Jr.
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Carol Cunningham
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Francesco Pompei
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Marc Tipermas
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Richard A. Aparo
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Paul J. Sugarman
Patrick B. Sullivan
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Edward J. Vaver
Gus J. Vlahakes
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Joseph A. Auer, Jr.
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Lawrence S. Bacow
Carliss Y. Baldwin
Bradley C. Billedeux
John M. Bissell
Jason I. Bitsky
Kenneth M. Brown
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B. Katherine Swartz
Michael F. Sweeney
John W. Taylor
Nagasato Uchida
R. Daniel Witschey, Jr.
Albert S. Yee
John M. Yee

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Barton W. Adrian
Clifton P. Allen
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Jay F. Benesch
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Vincent F. Chiappetta
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Alan Cisar
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Elaine Kant
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Alice Marie Sprouse
Paul A. Swartz
William W. Toy
John C. Weaver
Lawrence E. Widman
David R. Wilson
John D. Wright
Charles A. Ziering, Jr.

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David C. Aldrich
M. Michael Ansur
Edwin M. Arrippol
Anne E. Bossi
Brian J. Bosy
Charles H. Brown, Jr.
Ludwig C. Chang
Frank Commons

Dee A. Crouch
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Piero DiCapua
Michael Peter Filosa
Matthew Fowler
David Alan Fox
Edward C. Giaimo III
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David Steven Gromala
Edward J. Hanley, Jr.
Richard Alan Hartman
Rodney C. Hartman
Michael J. Hassett
Charles Edward Hillman
Bruce Irwin Judelson
Bruce A. Karmal
Stephen Matthew Kent
Harold Milstein
Kenneth Paul Minneman
Gary H. Miyashiro
Andrew W. Moehlenbrock
Roy Shiller Neff
Barry Nathan Nelson
Patricia Lynn Newbold
Seth M. Powsner
Steven Jay Projan
Gary David Raymond
Laurence H. Reece III
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J. Alan Ritter
Brian John Rossin
Elizabeth Lam Schreuren
David A. Shiang
Scott Howard Shlechter
Grant Norman Smith
W. Wayne Stargardt
Jonathan Bart Tepper
John Paul Tierney, Jr.
Alan L. Unemori
Jay W. Van Dwingelen
Jeffrey C. Weinreb
Douglas W. White
W. Paul Zampol

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John H. Austin
Richard A. Barron
Wesley S. Blank
Peter P. Blanshan
Daniel E. Breen
Patricia R. Callahan
Edward W. Capparelli, Jr.
David W. Chen
Harold M. Cook
Paul M. Davison
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Alan G. Epstein
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Frank P. Fezzie, Jr.
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Michael Levine
Carol Livingstone
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Robert W. Mann, Jr.
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R. Scott McKenzie
Anne McKinnon
Denny E. Morgan
Scott H. Oldach
Alexander Pankow
Arthur P. Rosiello
Alan J. Schimmel
Robert P. Schreiber

F. Patrick Schultz
Paul H. Siegel
William M. Silver
Joseph A. Sorge
Richard L. Stadterman
Richard M. Stratt
Lena S. Sun
Clifford L. Wald
Michael E. Wilens
David C. Yauich

1976

Robert J. Aquadro
David A. August
Milton F. Austin
Clark M. Baker
Eric L. Bogatin
Michael A. Bookman
Eugene Y. Chang
Thomas P. Chang
Leslie R. Chermak
Caroline Chiles
Marilyn Taggi Cisar
Michael W. Dziekan
Jeffrey A. Grossman
Jeffrey S. Halis
John J. Hanzel
Mark A. Holthouse
Douglas M. Johnston
Neil E. Kaden
Lawrence Kernan
James W. Lambert
Campbell M. Lange
David L. Lee
Reynold Hans Lewke
William H. Menke
Ray Merewether
Jerry D. Metz
James S. Miller
Kenton C. Murphy
Susan A. Riedel
Burt L. Rubenstein
Linda Sax Crossland
David C. Shaver
Lee M. Silberman
Susan Lyon Smolinski
Gerald E. Tourge
Richard P. Trubiano
James P. Wajda
Gail M. Walker
John E. Wiele
Benson K. Woo

1977

Andre K. Y. Au
Steven R. Bader
Robert E. Biebler
Eric D. Black
Carlos H. Blohm
Richard W. Buck
Michael C. Cohen
James E. Corning
Robert S. Cotta
David A. Dobos
Peter C. Doerschuk
Daniel I. Drake
T. M. Eubanks
Leonard N. Evenchik
Paul E. Fallon
Thomas B. Fetter
Peter J. Fiekowsky
Todd S. Glickman
Thomas C. Gooch
Michael J. Haney
Leo P. Harten
Michael S. Kaiser
Stephen W. Keith
Frank A. Kreimendahl
Thos A. Kush
Peter H. Kwon, Jr.
Manuel T. Lowenhaupt
Paul R. Menard
Kevin B. Miller
Thomas C. Mills
Charles G. Mogged, Jr.
Timothy F. Morison
Russell T. Nevins
Robert M. Russ, Jr.
Richard M. Smiley
Steven H. Spiro
Arlie G. Sterling III
Daniel G. Sundberg
Leslie Faye Sutton
Barbara A. Thornton

Louis L. Touton
L. Watlington
Keith B. Weldon
William F. Whitelaw
Robert L. Willmore

1978

Diana L. Barco
Howard S. Baron, Jr.
Kevin F. Brennan
Richard H. Brudnick
Frederic J. Bunke, Jr.
William Ceruzzi
William Chih Hsin Chao
Trieu C. Chieu
Peter C. Coffee
David E. Hartig
Chester A. Hayes
James J. Heeger
James V. Impara
John W. Jarve, Jr.
Susan L. Kayton
Kathy L. Kiemeyer
Kenneth I. Li
John N. Little
Carl D. Lutz
David E. Mayer
Donald B. Mellen
Naomi Johnson Miller
Barbara K. Ostrom
Anthony L. Otten
Cordelia M. Price
Robert G. Resnick
Leslie Rosenthal Shlechter
Howard Shao
Andrew A. Stern
Michael D. Waxman
Steven C. Webster
Scott R. Westbrook
Arthur Wright

1979

Gary W. Ashley
Douglas C. Barnard
Lisa M. Bendixen
Tim E. Blamptis
Susan Jane Colley
Hoyt L. Davidson
Keith L. Dimorier
Jeffrey N. Dugal
Richard W. Dykstra
Mark P. Favreau
John J. Fratamico, Jr.
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Robert E. Gompf
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Andreas G. Hegedus
David S. Heller
Dale V. Hodson
Stephen K. Kenda
John F. Kenny
Sally C. Kornfeld
Richard P. Kuntz
David R. A. Lewis
Gerald T. Michael
David D. Miller
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Eugene Novacek
Lee S. Parks
Brenda Pomerance
John F. Pries
Jonathan A. Reiss
Bruce J. Roberts
Larry S. Rosenstein
Charles B. Roxlo
Jeffrey J. Russell
Carlo R. Russo
Jeffrey I. Schiller
Kenneth J. Schroder
Carol Cesari Tourgee
Pei-Ti Tung
Scott H. Wayne
Anne Michon Westbrook
Edmund L. Weston III
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Eric N. Whitney
William T. Wood

1980

Frederick D. Baker
Jeffrey H. Berman
Russell Blount
Joseph S. Broz
Rodney D. Cadanau

David L. Cameron
Jane H. Chronis
Thomas A. Curtis
Ronald A. Efromson
Thomas E. Faust, Jr.
Jean Fischer Bandy
Steven E. Golson
Ralph A. Hulseman
Frank E. Huston
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Barbara M. Johnston
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David P. Moosher
Kenneth D. Oya
Brian J. Picht
Keith A. Thompson
Susan J. Tiffany
Richard W. Tucker
Debra A. Utko
William R. Welke

1981

Aaron F. Bobick
Lauren A. Christopher
Walter R. Crosby
Charles T. Dale
Catherine Renaud Doiron
Tso Yee Fan
John R. Fierke
Ellen C. C. Fischer
Jenny M. Ford
Jonathan M. Friedman
Joel T. Garcia
Mark Hellinger
A. David Himle
Louisa Ho
Judith K. Lemire
Duane T. Nakahata
William I. Ogilvie
Pamela G. Standley
Douglas S. Swanson
Eric D. Thiel
Christopher S. Wheeler
Dale E. Zimmerman

1982

Arno S. Bommer
Michael J. Colucci
Michael G. Feinstein
Charles Frankel
Aki Fujimura
Linda M. Garverick
David P. Harauy
Fred W. Helenius
Grace L. Malloy
Cynthia A. Nicholson
Charles F. Palmer, Jr.
Matthew Prete
Monica M. Reynolds
Philip B. Romanik
Galen W. Seitz
Steven J. Snider
David I. Solo
Siok T. Thio
Lars Toomre
Katherine A. Yelick
Chi-Won Yoon

1983

Paul S. Cunningham
Brilsford B. Flint
Karl W. Frey
Matthew K. Haggerty
Jeffrey E. Harris
Audrey C. Hopkins
Lawrence J. Kaufman
Kenneth W. Krugler
Thomas Maciowski
Barry Magrolin
Katharine A. Marvin
Hyun-A C. Park
Patricia A. Smith
Simon D. Trieu
Robert Varkonyi
Roy M. Weinstein

1984

Russell L. Brand
Steve M. Dubnik
Richard B. Feldman
Kenneth R. Grant
Ralf Harteneck
Michael T. Howard
Steven K. Knapp

Thomas R. Kohut
Michael E. Landmeier
Chunka Mui
Michael J. Repeta
Jeffrey L. Schenck
Paul J. Shim
Valeri H. Terry
Kenneth R. Traub

1985

Atul Jain
Kim A. Marvin
Prisca Chen Marvin
Jeffrey S. Moore
Stephen N. Schwoerke

1986

Khaled S. Masri
Mary C. Ystuenta

1987

William H. B. Habeck
Jerald R. E. Tracy
Hong M. Yang

1988

Christine A. Chu

1989

David B. Krakauer

1990

Eloisa C. Tejero

Advanced Engineering Studies

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Toshiaki Nagaya '88
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G. Robert Parker, Jr. '70
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Elliot Saltzman '51
John I. Schlossman '56
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Russell Kuo-Fu Chan '74
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Edward C. Hume III '83
Shingo Ishikawa '79
Hugh Robert James '74
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Luis Jaw '57
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Timothy Lee Montgomery '74
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John H. O'Neill, Jr. '51
R. Robert Paxton '49
Donald W. Peaceman '51
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Hugh W. Schwarz '42
James Seth '36
Francis L. Shackelford, Jr. '40
Yen Shen '42
Robert E. Siegfried '47
Robert S. Smith '47
Yihong Song '78
Carl W. Streed '41
T. J. Suen '35
Jefferson W. Tester '71
Hsueh-Rong Chang Tong '81
Preetinder S. Virk '67
Willard E. Wadt '33
Charles K. Walker '40
Douglas J. Warner '59
James C. Wei '54
John A. Wilkens '77

Civil Engineering

Joseph Antebi '57
Fredric S. Berger '84
Robert N. Block '81
Richard B. Bovee '70
Shing-Ching Chan '71
Kenneth C. Deemer '52
Fernand N. de Waziers '77
Dennis M. Elliott '69
William Enkeboll '47
Justin J. Gershuny '53
Elias N. Hani '75
Robert L. Hardison '63
Kent A. Healy '63
Cecilia C. Hsiung '68
Yoshihiro Ichikawa '68
Joseph J. Kaelin '86
D. C. Koutsostas '72
Philippe Lamarre '89
Thomas D. Landale '54
Norman W. Llewellyn '49
Richard C. Lundberg '66
William O. Lynch '47
Fuji Matsuda '52
James H. Maxymilian '61
Harley L. Moore III '73
Yasuo Mori '68
William A. Moylan '80
Tavit O. Najarian '75

Lucile S. Wilkens '77
Byron B. Woertz '39
W. Kelly Woods '36
William W. Yuan '59

Chemistry

George A. Auld, Jr. '68
Lawrence N. Bell '68
Rene R. Bertrand '62
Kofi Bimpong-Bota '75
James J. Bishop '69
C. John Blankley '67
Lawrence H. Bowen '61
Carl H. Brubaker, Jr. '52
Robinson D. Burbank '50
Robert L. Cargill, Jr. '60
John A. Carson '68
Howard S. Corey, Jr. '55
Clifford L. Creel '76
G. Doyle Daves, Jr. '64
Susan M. Fredericks Davis '80
Donald R. Doulsen '48
Hugh L. Dryden, Jr. '50
Gareth R. Eaton '72
Sandra S. Eaton '72
J. David Ellett, Jr. '70
Louise H. Foley '70
J. Stuart Fordyce '59
Lionel S. Galstaun '34
Robert B. Giles, Jr. '44
Kenneth M. Gordon '76
A. Thomas Hallowell '40
Edward A. Ham '51
Paul F. Hogan '68
John W. Irvine, Jr. '39
Frederick O. Johnson '50
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Christopher E. Kalmus '72
Dieter H. Klaubert '71
Peter Kulsa '68
Robert L. Lambert, Jr. '73
Linda D. Lu Chang '82
Kin-Chun T. Luk '77
Joseph X. McDermott '75
William C. Mills III '81
Harold R. Nace '48
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Clark W. Perry '63
William D. Phillips '51
Joseph E. Rousseau, Jr. '52
Richard T. Ruettiger '68
Hubert J. P. Schoemaker '76
Arnold M. Schwartz '74
Edward M. Shawl '70
Yen-Shiang Shih '79
Ching-Fong Shu '88
Emil J. Slawinski, Jr. '49
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Charles G. Wade '65
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Richard L. Wasson '56
Frederick K. Watson '36
Emily L. Wick '51
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Civil Engineering

Joseph Antebi '57
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Robert N. Block '81
Richard B. Bovee '70
Shing-Ching Chan '71
Kenneth C. Deemer '52
Fernand N. de Waziers '77
Dennis M. Elliott '69
William Enkeboll '47
Justin J. Gershuny '53
Elias N. Hani '75
Robert L. Hardison '63
Kent A. Healy '63
Cecilia C. Hsiung '68
Yoshihiro Ichikawa '68
Joseph J. Kaelin '86
D. C. Koutsostas '72
Philippe Lamarre '89
Thomas D. Landale '54
Norman W. Llewellyn '49
Richard C. Lundberg '66
William O. Lynch '47
Fuji Matsuda '52
James H. Maxymilian '61
Harley L. Moore III '73
Yasuo Mori '68
William A. Moylan '80
Tavit O. Najarian '75

Asaf A. Qazilbash '65
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Max M. Ulrich '51
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Charles R. Walker '48
Louis M. Wenick '77
Stanley M. White '76
Robert L. Wilcox '55
Roger H. Wingate '37
P. Huey Wong '46
Michel H. Zaleski '71

Earth, Atmospheric & Planetary Sciences (includes Meteorology)

James M. Beall '42
Sara L. Bennett '88
Carlton L. Bjerkaas '77
Albert M. Bottoms '62
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Charles C. Schnetzler '62
Raymond C. Staley '45
Alfredo A. Suarez '71
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Scott D. Thayer '48
Robert M. White '49

Economics

Marcelle V. Arak '67
Ellen Burton '82
Sidney E. Chernick '56
Leslie Cookenboo '53
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Stephen Martin '77
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Electrical Engineering & Computer Science

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Yukio Ito '78
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Bruce A. Jamerson '75

Elizabeth P. Jensen '78
Erik J. P. Jensen '78
Ronald R. Jensen '65
Paul David Kaplan '74
Norman K. Kidder '75
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Saman Majd '85
Nikhil Malvania '78
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Humanities & Science

Karan A. Shelley '73

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Relva C. Buchanan '64
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Jang-Hi Im '76
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Walter Nummela '63
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Nannaji Saka '74
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Mathematics

Bruce H. Baguley '75
Alan E. Berger '72
Joseph J. Buff '77
Pierre A. Carrus '49
Robert A. Clark '49
Stephen H. Crandall '46
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Phyllis Fox '54
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Robert F. McIntosh '51
Hironori Onishi '61
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Nancy K. Stanton '73
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Mechanical Engineering

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E. N. Carabateas '59
Ping C. Chan '79
John C. Chato '60
Lawrence S. Daniels '66
Brit-Marie D'Arbeloff '61
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Woodie C. Flowers '73
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Lorne G. Greenwood, Jr. '61
Charles C. Hansen III '47
David E. Hardt '79
Serope Kalpakjian '53
Peter Kalustian '34
Enrique L. Kilayko '60
Raja T. Kort '81
George A. Lavoie '70
Lloyd J. Lee '61
Lawrence H. Linden '76
David G. Lutz '85
Francis S. Lynch '68
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Gail E. McCarthy '78
Roger L. McCarthy '77
Bora Mikic '67
Marlen L. Miller '54
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Pangal R. Nayak '68
Robert L. Nisonger '78
Ravinder K. Sakhuja '71
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Watson E. Slabaugh '30
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Bryon W. Stutzman '66
Kwai-Yung B. Su '80
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Philip A. Thompson '61
Chee C. Tung '66
Jan A. Veltrop '53
Chiao J. Wang '46
Paul A. Wieselmann '69
Homer J. Wood '40
Leroy C. Worley III '73
Francis J. Zimmermann '50

Nuclear Engineering

Dennis C. Bley '79
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Alan R. Forbes '78
John S. Hendricks '75
Charles L. Larson '59
Victor J. Orphan '64
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Howard C. Shaffer III '76
Rung C. Tang '78
Michael Todosow '77
Chon-Kwo Tsai '85
Robert J. Witt '87

Nutrition & Food Sciences

Charles J. Bates '57
Darshan S. Bhatia '50

Charles L. Cooney '70
Roger T. Keefe '76
Rufus E. Lester, Jr. '56
John F. Maloney, Jr. '65
John C. Sluder '41

Ocean Engineering (includes Naval Construction)

Ralph E. Barnard '52
Norman K. Berge '60
James J. Burgess '85
Raymond E. Cunningham '70
Charles A. Curtze '38
W. E. Dennis '49
James A. Fay '47
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Leroy V. Honsinger '32
Keh-Sik Min '78
Ich T. Nguyen '71
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Manolis Papamichael '77
Stephen M. Patten '63
Pramud Rawat '61
S. W. Williston Shor '49
Alexander J. Tachmindji '51
Erik C. Tiemroth '81
Charles M. Toock '33
Raphael L. Vermeir '79
Otto A. Zipf '63

Physics

J. Milton Andres '53
James E. Archer '50
Elizabeth E. Cox '63
Peter T. Demos '51
Robert A. Dudley '51
Robert O. Ginaven '66
Eugene I. Gordon '57
T. Marshall Hahn, Jr. '50
John A. Harvey '50
Lincoln B. Hubbard '67
Yuji Ito '67
Benjamin Lax '49
Paul D. Lazay '69
J. David Lister '65
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Leonard C. Maier, Jr. '49
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Kenneth B. Newbound '48
Charles S. Roberts '63
Joseph E. Robertshaw '58
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Allen L. Rubenstein '67
H. Michael Schulz III '67
E. Leigh Secrest '51
Richard B. Stambaugh '41
Parr A. Tate '53
Lawrence G. Votta, Jr. '79
Robert C. Walker '77
Michael K. Wilkinson '50
Myron L. Zimmerman '79
Sidney F. Zimmerman, Jr. '55

Political Science

William W. Lazarus '84
Enid C. B. Schoettle '67
Deborah A. Stone '76
Archelaus Rye Turrentine '74
Kevin M. Upton '74
Taizo Yakushiji '75

Psychology

Martha E. Hardt '73
Kwok-Fai So '77

Senior Executive Program

Malcolm W. Boyce '85
Howell S. C. Chou '69
Samuel B. Coco, Jr. '64
Siegfried K. Hodapp '80
Robert L. Pennock '73
Lovett R. Smith, Jr. '57

Sloan Fellows Program

F. Duane Ackerman '78
Nabil I. Al-Bassam '77
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Ray W. Ballmer '60
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Richmond W. Bourne, Jr. '84
William L. Bucknall, Jr. '80
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Alfred A. Chacon '85
Fredric S. Cohen '76

Wendel W. Cook '68
John D. Debbink '56
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Roger W. Hale '79
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Ronald L. Heideke '77
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Nathaniel S. Howe '62
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Walter B. Kelley '52
Thomas E. Kelly III '83
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Lily K. Lai '83
Linda J. Laskowski '84
Tetsuya Matsuoka '85
Stanley J. McLaughlin '83
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Gerald S. Rosenfelder '67
Gerhard H. Schulmeyer '74
James W. Shaw '80
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Robert L. Smith '78
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Edward Steinhoff '71
John D. Stubbs '77
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Robert W. Van Niel '72
Ormand J. Wade '73
Robert H. Wallace '54
George W. Waller '88
Thomas L. Watts '80
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Kay R. Whitmore '75
Dennis F. Wilkie '80
Ronald A. Williams '84
Hugh E. Witt '57
Gordon T. Yamada '62
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Richard S. McCurdy '70
Ivan R. Sprung '67

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Gregory H. Zehner

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Gary M. Zentner

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Ralph J. Spicer
William K. Stewart
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Lisa B. Weil
Robin M. Whitworth
Boris N. Yost
Gregory H. Zehner

1989

Eric T. Anderson
Tatal M. Bahrani
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Henry H. Houh
Patrick M. Leonard
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And One for the Monkey

It has been at least a year since I specified the size of the backlogs for the various kinds of problems that are printed. Let me do so now. I have over a year's supply of regular and speed problems and a half-year's supply of bridge problems—but computer and chess problems are in short supply.

My classmate John Rudy reminds me that our 25th reunion will occur next year and asks if some special event could be run in "Puzzle Corner" to acknowledge the event. Although the anniversary of my graduation may not be a noteworthy event for the column, a related anniversary is. November 1966 was the first appearance of "Puzzle Corner" in *Technology Review* after a year in the (now defunct) student-run *Tech Engineering News*. Hence we are just a half year away from our 25th anniversary. Any suggestions on a possible anniversary event?

Problems

APR 1. Robert Bart offers the following six-card problem that is thought to have been invented to test the powers of the legendary Oswald Jacoby. South is on lead with spades trump and is to make 5 of the 6 tricks against best defense.

NORTH

♠ A J 4
♥ J 6 2
♦ -
♣ -

WEST

♠ Q 8 7
♥ -
♦ -
♣ Q 8 7

EAST

♠ -
♥ Q 8 7
♦ Q 8 7
♣ -

SOUTH

♠ K 9 6 5
♥ J 6
♦ -
♣ -

APR 2. Warren Himmelberger sent us an old chestnut (really an old coconut) involving a monkey and some monkey business. In addition to the original problem, which is given below, Himmelberger suggests some interesting generalizations. Anyone interested in these extensions should write to the editors of *Technology Review* and ask for a copy of Himmelberger's February 1973 article from the *Mathematics Teacher*.

Four men are going to divide a pile of coconuts equally the following day. But, during the night, the first man decides to take his share secretly. He divides the coconuts into four piles, finds there is one nut left over and gives it to the monkey. He takes his share and puts the other three shares back. The second, third, and fourth man, in turn, proceed to do the same thing, each giving his share, and returning the other three shares to the pile. Then, in the morning, the four men meet to divide the remaining nuts into equal shares, and find there is again one nut left for the monkey. The puzzle is to find the least number of nuts in the original pile.

APR 3. Stephen Callaghan proposes the following problem. It looks difficult to me but I have been proven wrong in this regard before! You are to find the number of "distinct" $m \times m$ matrices with $n < m$ 1s and $m - n$ 0s in each row and column. Two matrices are considered equivalent (i.e. not distinct) if one can be converted to the other by permuting the rows and the columns. As an example, for $m = 4$ and $n = 2$, the following two matrices are distinct.

1 1 0 0	1 1 0 0
1 1 0 0	1 0 1 0
0 0 1 1	0 1 0 1
0 0 1 1	0 0 1 1

Speed Department

Phelps Meaker wants to know at what time between two o'clock and three o'clock will the minute hand be exactly sixteen minute spaces counterclockwise of the hour hand?

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Hartford College for Women; president of the New Britain Chamber of Commerce and the Danbury Chamber of Commerce; advisory director of the Connecticut National Bank; and has served on the boards of hospitals, community chests and the American Red Cross.

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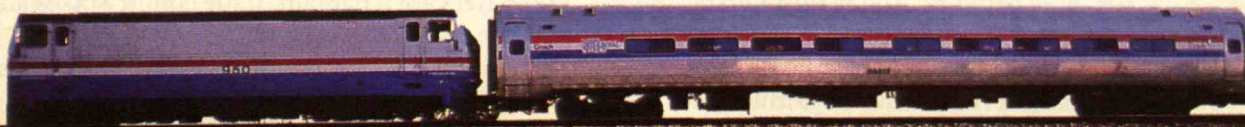
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low off-peak cost, overnight transcontinental pullman service, economical freight service, and highway vehicle ferrying. As such a system takes shape, demand will gradually increase, allowing costs to drop enough to stimulate further demand. And the more popular a travel mode becomes, the faster technological innovation occurs, driving performance up and cost down.

I believe maglev will be a welcome alternative to the frustrations of existing modes and that it will garner enough support to grow rapidly. The skeleton 10,000-mile national magway system is feasible today and could be expanded as demand justifies.

Financing and Operating the Magway System

So far, the federal government has maintained that maglev must be developed by private industry and that the only role of government is to support early R&D. Because of the risks and uncertainties, however, industry has been reluctant to get involved with maglev other than as contractors on government-supported R&D. Thus a nationwide maglev system is unlikely to materialize unless the federal government makes the first move by financing not only research but early construction as well. In the past, transportation technologies have developed commercially only after the federal government became a leader.

In the case of railways, for example, the federal government gave 13 million acres of land grants to 29 railroads so they could build 18,000 miles of line. This is far more land than is now occupied by all of the nation's railways, interstate highways, and airports combined. In 1862 Congress passed an act to finance construction of the Union Pacific Railroad, and work commenced. But it was soon clear that private investors were unwilling to buy bonds. Congress was forced to make more land grants and passed another act to provide capital stock, with no promise of repayment. As soon as the Golden Spike was driven, uniting the Union Pacific and Central Pacific railroads, the undertaking became a success. Investors rushed to build railroads; in a single year—1887—12,876 miles were built with private financing.

Similarly, the federal government stepped in to finance the interstate highway system once it became apparent that states would not make major commitments. President Eisenhower got the critical legislation passed in 1954. But even then, the effort failed until the Highway Revenue Act of 1956 provided funding for an accelerated program of construction. Federal gasoline taxes allowed the creation of the Highway Trust Fund, which paid 90 percent of the construction cost of the 43,500-mile network. Today the interstate highway system carries 20 percent of the nation's traffic on 1 percent of the roads.

The story of airport construction is much the same.

Before 1946, airports were financed and operated by state, county, or municipal governments. But because development was slow, Congress passed an act that laid the groundwork for a comprehensive system of airports. The federal government paid up to half the cost of building facilities; the local sponsor paid the balance. The act was later extended through 1961.

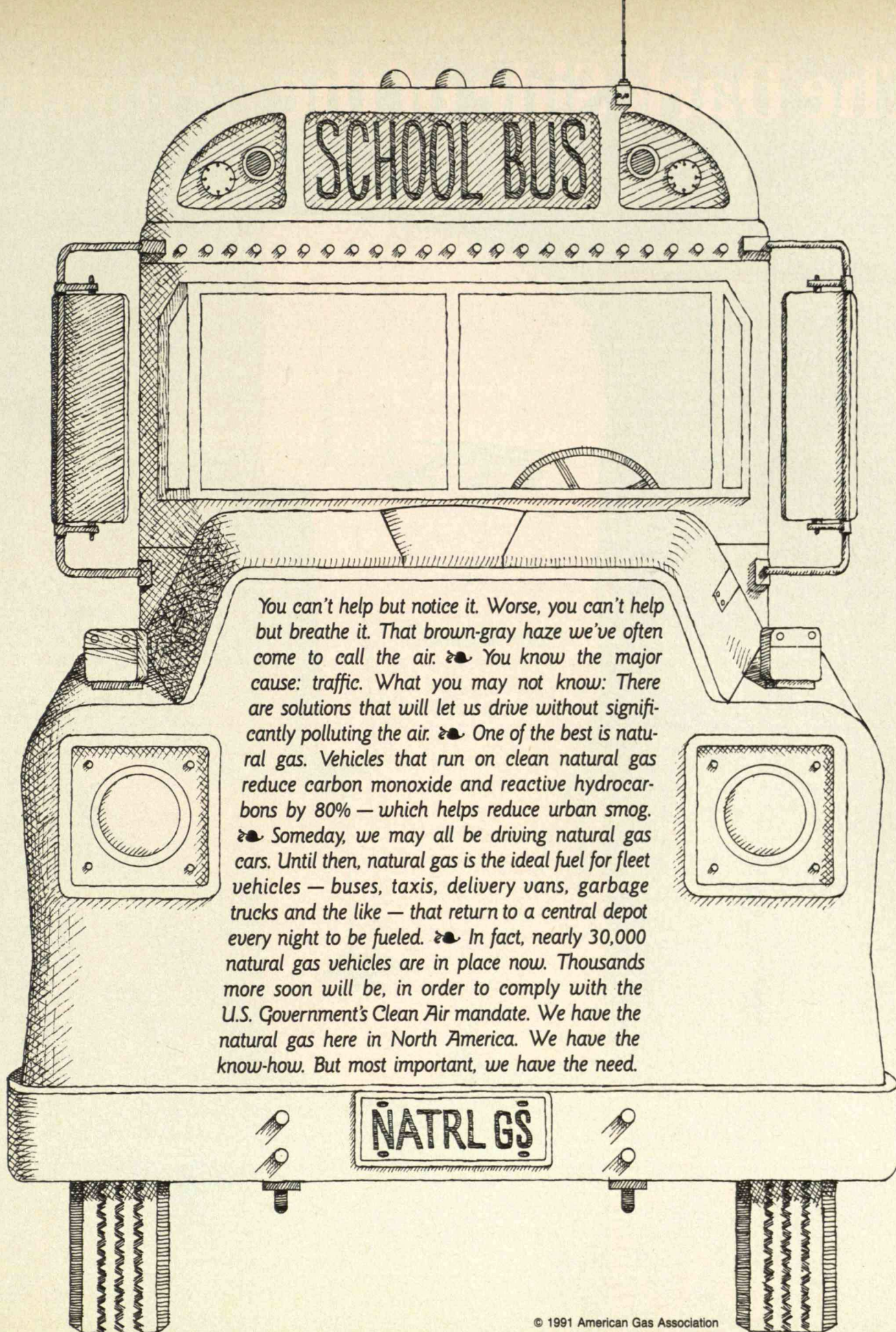
In all these modes of transportation, the government has been amply repaid for its initial investments. When the profit potential was clearly evident, industry and the states were willing to invest large sums. U.S. taxpayers have received a better bargain for taxes invested in transportation infrastructure than for many other federal expenses.

The United States has fared well with a number of mechanisms for funding large projects that could not be initiated by private industry alone. Airports and interstate highways, for example, were constructed with trust funds. Communications satellites were funded through the formation of Comsat, a quasi-private corporation. And the coal gasification project of the 1970s relied on a partnership approach.

Although political leaders are well able to select the best mode of nurturing a national magway system, the prevailing opinion favors using a trust fund for financing, and consortia of industry and academia for development. At first, the money for the trust fund can come from similar funds for other modes of travel, because maglev will reduce the need to draw from those funds. Eventually, the maglev trust fund must receive enough revenue from maglev service to pay for all construction and maintenance, and help finance still newer transportation projects.

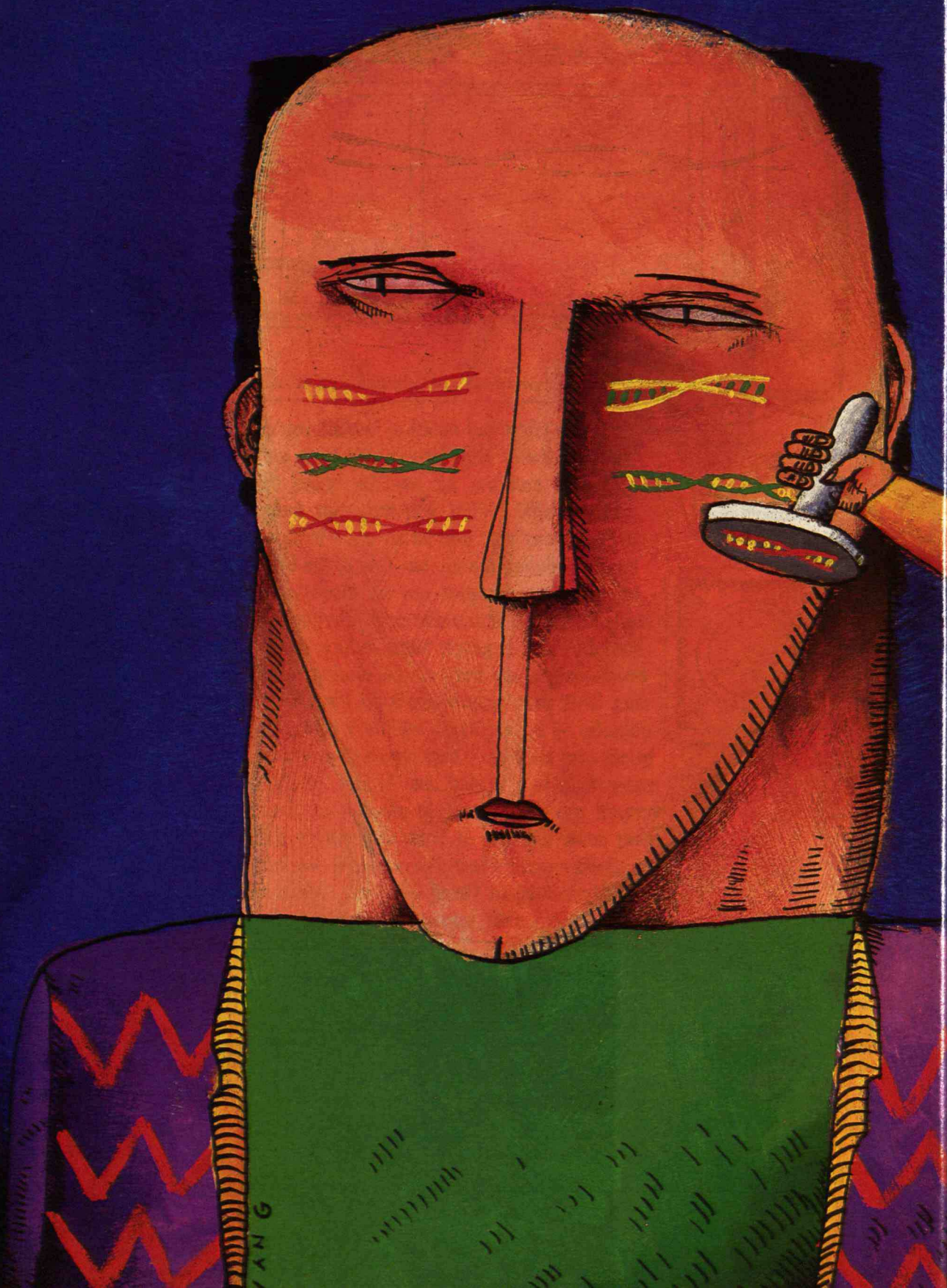
Like highways, magways should be built and operated by suitable state or quasipublic agencies. As for the vehicles, private industry can finance their design and manufacture after the initial government-supported R&D phase. A variety of public and private entities—charter-bus companies, airlines, express-mail firms, government agencies, and so forth—can be encouraged to operate passenger and freight service in an essentially unregulated environment, and with vehicles and drivers appropriately licensed. Guideway fees and energy charges should be handled like telephone charges, with automatic billing.

Those who doubt that the United States can develop maglev successfully should recall the country's record of standing at the forefront of all new transportation technologies, from railways to highways and airways. In these earlier transportation revolutions, the government ended up providing suitable support when needed in spite of rhetoric to the contrary, and ultimately the taxpayers got a bargain. If the country takes advantage of the window of opportunity offered by second-generation maglev, it will be repaid no less handsomely for its initiative. ■



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The Dark Side of the Genome



The effort to analyze

*humans' genetic makeup could lead
to a dangerous belief in genes as the
ultimate determinants of who we
are and how we think.*

In



the past 10 years biology has undergone a revolution that has repeatedly attracted wide attention. At first, controversy swirled over whether the genetic cloning technology that powers this revolution could create new and possibly dangerous forms of life. These fears have dissipated as thousands of investigators have found that the organisms created by gene splicing pose no threat to human health or the ecosystem around us.

A much larger stream of headlines next touted the power of genetic engineering to produce great quantities of valuable medical and agricultural products cheaply. Without doubt, over the next decades these fruits of biotechnology will enormously benefit health and economic productivity.

Largely lost amidst these stories, however, are developments that will ultimately have a far larger social impact. Recently gained abilities to analyze complex genetic information, including our own, will soon allow us to predict human traits from simple DNA tests. By the end of the 1990s, routine tests will detect predispositions to dozens of diseases as well as indicate a wide range of normal human traits. We have only begun to confront the problems engendered by the power of genetic diagnosis.

Consider, for example, the societal problems that will likely develop from the recent isolation of the gene that in a defective form causes cystic fibrosis. Genetic counselors can now trace that version of the gene in families, thereby revealing those couples who could have children with cystic fibrosis. While providing extraordinarily useful information for cystic fibrosis carriers, this technique raises questions about the marriage-

BY ROBERT A. WEINBERG

ILLUSTRATIONS: JAMES YANG

ability and reproductive decisions of gene carriers, and the terms under which their offspring will be able to obtain health and life insurance.

Individual successes like the isolation of the cystic fibrosis gene will soon be overshadowed by the avalanche of genetic information flowing out of research labs. The engine that will drive these advances in gene analysis is the biologists' moonshot, the Human Genome Project (see "DNA and Babylonian Tablets," page 51). The ambitious goal of this international effort is to read out the sequence of the 3 billion bases of DNA that, strung end to end, carry the information of all the body's genes. Given a clear, easily read atlas of our genetic endowment, researchers will be able to accelerate the rate at which they discover important genes—now several dozen each year—by 10-fold and eventually maybe even 100-fold. Scientists will then be able to study how the normal versions of these genes work, and how their aberrant versions cause disease.

Some fear that by reading through the entire library of human gene sequences we will rapidly come to understand the ultimate secrets of life and the essence of our humanity. For my part, such fears are far astray of the mark. Our bodies function as complex networks of interacting components that are often influenced by our variable environment. By enumerating and studying individual components—genes, in this case—we will only begin to scratch the surface of our complexity.

Nonetheless, certain genes can be especially influential in determining one or another aspect of human form and function. Herein lie the seeds of the substantial problems we will begin to encounter over the next decade.

Mapping the Genetic Terrain

Ten to fifteen years from now—barring unforeseen technical obstacles—scientists will have described every bump in our complex genetic terrain. Yet long before the project is finished, information yielded by "mapping" this landscape—breaking it into sectors of manageable size and placing them in a logical array—will make possible powerful genetic analysis techniques. These, in turn, will engender a host of ethical issues.

To understand why, it is important to know a little about the underlying biology. The human genetic landscape—our genome—consists of all the DNA information carried on the 22 pairs of chromosomes in

our cells plus the X and Y chromosomes involved in determining sex. Each chromosome carries a linear molecule of DNA ranging in size from 50 million to 250 million pairs of four kinds of chemical bases. They are commonly referred to by the letters A, C, G, and T. In all, 3 billion base pairs of DNA lie on the chromosomes. Some 50,000 to 100,000 discrete segments of DNA—each several thousand or more base pairs long—constitute the genes that store our genetic information. The trick is to figure out where these genes lie, and what information each encodes.

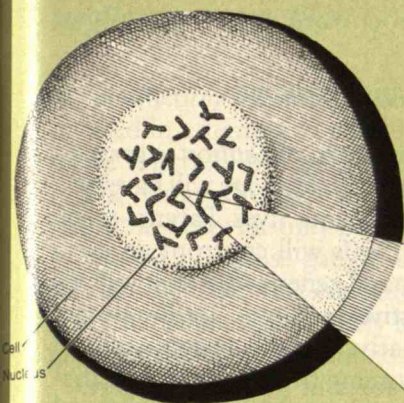
As a first step in understanding this enormous information base, investigators have started mapping each chromosome by labeling small segments along its length. The labels used are actually built-in features of the genome. They consist of minor genetic variations called polymorphisms that occur frequently throughout human DNA sequences and distinguish one person's DNA from another's. For example, at a certain chromosomal site, one person's DNA bases may read AAGCTT while a second person's may read AAGTTT. Such polymorphisms, widely scattered throughout the genome, are readily detected using existing techniques, even without any knowledge of the genome's detailed structure.

Polymorphisms are not only important for their usefulness in marking the genome at specific places. The location of a particular gene in the human genome is usually obscure. Geneticists can track down such a gene by localizing it near one or another polymorphic marker. To do this, they ascertain the presence of markers in DNA samples collected from members of large families and even large, unrelated populations.

Researchers have already used a polymorphic marker to determine the rough location of the gene that in one variant form, or "allele," leads to Huntington's disease. This illness appears as a severe neurological deterioration in midlife. Within a large kin group studied in Venezuela, all the relatives showing the disease were found to carry a distinct polymorphic marker on a particular chromosome, while their middle-aged, disease-free relatives did not. This concordance means that the still unknown gene lies close to the polymorphic marker on that chromosome, and therefore that detection of the marker signals the presence of the gene that causes the disease. The marker will prove invaluable in helping researchers to directly identify the Huntington's gene, isolation of which offers the only real hope for understanding and treating the disease.

Genes linked to terrible diseases are not the only ones geneticists study. During the next 10 years, researchers may well make associations between polymorphic markers and normal, highly variable traits such as

ROBERT A. WEINBERG is an MIT biology professor and member of the Whitehead Institute for Biomedical Research. His laboratory was among the first to recognize the existence of human oncogenes, which are responsible for converting normal cells into cancer cells.



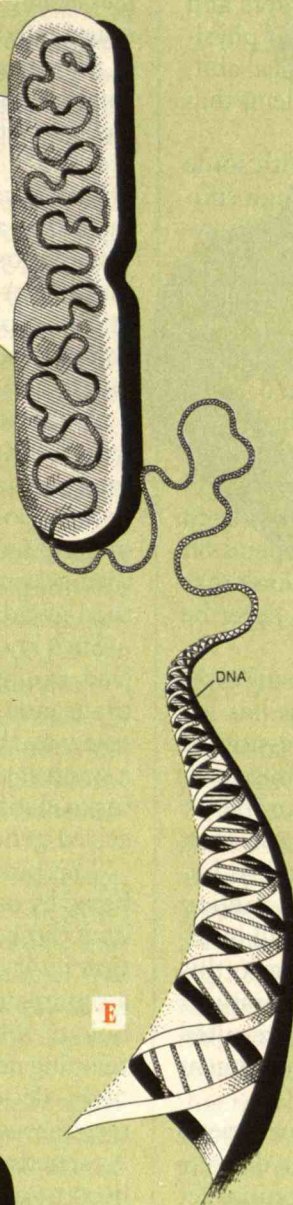
A

A Most cells in our bodies contain, within the 23 pairs of chromosomes in their nuclei, all of our genetic information.

B Each chromosome contains a single molecule of DNA. **C, D** Electron micrographs reveal how densely the DNA is actually packed. A close look at part of a chromosome shows dozens of DNA loops extending from a "backbone."

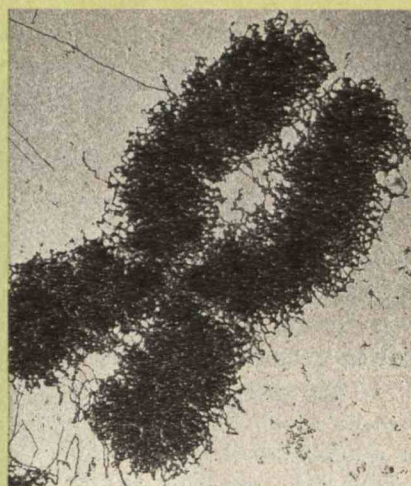
E, F An even closer artist's view shows DNA's double helix, a ladder-like structure whose "rungs" consist of paired chemical bases, abbreviated as A, C, G, and T.

B

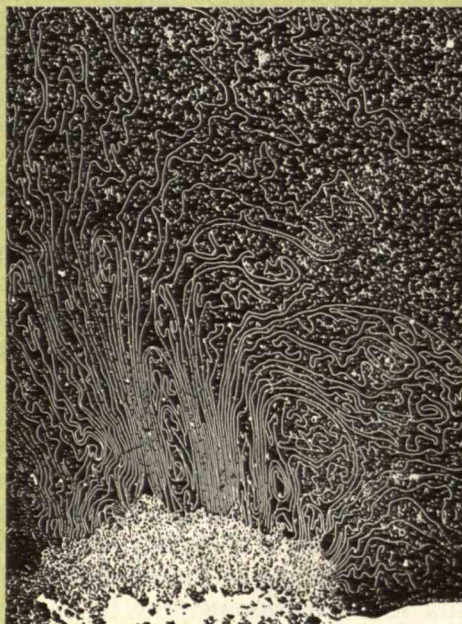


E

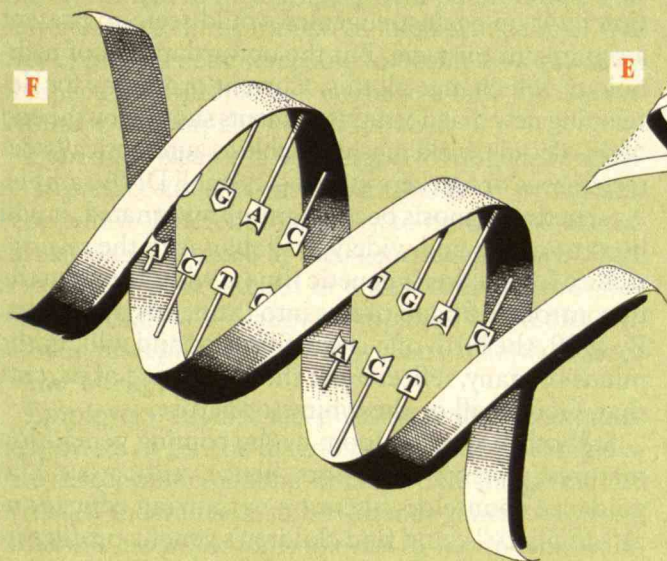
C



D



F



Thousands to millions of base pairs combine to make one gene. In all, our chromosomes include 50,000 to 100,000 genes and 3 billion base pairs. The goal of the Human Genome Project is to map these genes and other genetic milestones and determine the sequence of their base pairs.

height, eye color, hair shape, and even foot width without knowledge of the genes that serve as blueprints for these traits. Not much further down the road, scientists may uncover links between certain markers and more complex, subtle traits, such as aspects of physical coordination, mood, and maybe even musical ability. At that point, we will confront social problems that will bedevil us for decades to come.

Imagine that investigators could predict with some accuracy certain aspects of intelligence through simple analysis of an individual's DNA. Consider the power this would give some people and the vulnerable position in which it would put others.

The magnitude of the problems of genetic diagnosis depends on one's view of how many complex human traits will be successfully associated with polymorphic markers. Some observers, such as geneticists Richard Lewontin and Jonathan Beckwith of Harvard University, believe that few such associations will be made correctly. Some people argue that traits such as perfect pitch and mathematical ability depend on the workings of dozens of genes. Yet others think that the contributions of nature and nurture can never be teased apart.

Most likely, the doubters will be correct in many cases but wrong in others. Mathematical analysis has led some geneticists to conclude that the expression of many complex traits is strongly influenced by the workings of a few genes operating amid a large number of more silent collaborators. Moreover, scientists can most easily explain rapid organismic evolution, such as humans have experienced over the last several million years, by attributing important roles to a small number of especially influential genes. According to this hypothesis, each such gene has undergone alterations over the course of evolution that have in turn resulted in profound changes in our embryological development and adult functioning.

For these reasons, I believe that a number of genetic markers will be strongly linked to certain discrete aspects of human behavior and mental functioning. Yet other traits will, as some argue, prove to be influenced by many interacting genes and the environment, and will not lend themselves to the genetic analysis soon to be at our fingertips.

What type of higher functions will be understood and predictable by genetic methods? One can only speculate. The list of possibilities—say, shyness, aggressiveness, foreign-language aptitude, chess-playing ability, heat tolerance, or sex drive—is limited only by one's imagination. Likewise, the consequences of one or another identification—and there will surely be some successes—can barely begin to be foreseen.

The Long Reach of Genetic Screening

From cradle to grave—even from *conception* to grave—the coming genetic diagnostic technology will have profound effects on our descendants' lives. Parents-to-be in the latter part of the 1990s will confront an ever-lengthening menu of prenatal genetic tests that will affect a variety of reproductive decisions. Terminating a pregnancy may come relatively easily to some whose offspring carry genes dooming them to crippling diseases that appear early in life, such as Tay-Sachs and cystic fibrosis. But the mutant gene leading to Huntington's disease usually permits normal life until one's 40s or 50s, typically after the trait has been passed on to half of the next generation. Will its detection in a fetus justify abortion?

As the years pass, this gray area of decision making will widen inexorably. Sooner or later, an enterprising graduate student will uncover a close association between a polymorphic marker and some benign aspect of human variability like eye color or body shape. And then genetic decision making will hinge on far more than avoiding dread disease.

Such knowledge and the tests it makes possible could lead to eugenics through elective abortion. In India, thousands of abortions are said to be performed today solely on the basis of fetal sex. It would seem to be but a small step for many to use the genetic profile of a fetus to justify abortion for a myriad of other real or perceived genetic insufficiencies.

This prospect may appear remote, seemingly encumbered by complicated laboratory procedures that will limit these analyses to a privileged elite. And the revolution built up against eugenics would seem to present a significant obstacle. But the onward march of technology will change all this. Current programs for developing new diagnostic instruments should, by the end of this decade, yield machines able to automatically detect dozens of markers in a single, small DNA sample. As genetic diagnosis becomes more automated, it will become cheap and widely available. And the responsibility for children's genetic fitness will shift from the uncontrollable hand of fate into the hands of parents. By 1999, the birth of a cystic fibrosis child will, in the minds of many, reflect more the negligence of parents than God's will or the whims of nature.

Still other specters loom as the coming generation matures. Twenty-five years hence, educators and guidance counselors intent on optimizing educational "efficiency" could find children's genetic profiles irresistible tools. Once correlations are developed between performance and the frequency of certain genetic sequences—and once computers can forecast

The birth of a child with a genetic disease will soon seem to many to reflect parental negligence more than God's will or nature's whim.

the interactions of multiple genes—such analyses could be used in attempts to predict various aspects of cognitive function and general educability.

The dangers here are legion. Some will use tests that will at best provide only probabilistic predictors of performance as precise gauges of competence. And factors strongly affecting education, including personality and environment, will likely be overlooked, leading to gross misreadings of individual ability.

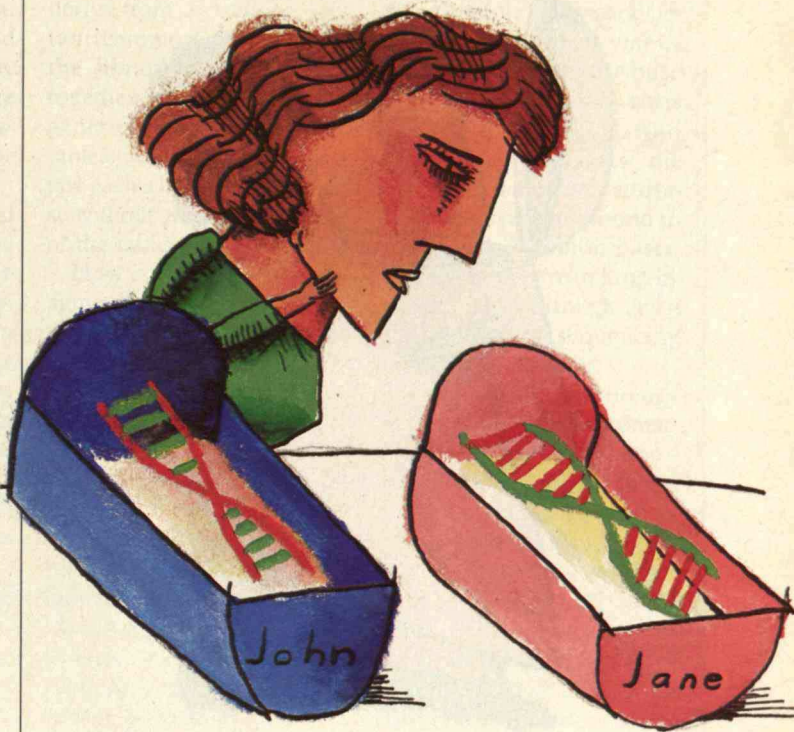
Only slightly less insidious could be the effects of genetic analysis on future marriages. Will courtships be determined by perceptions of the genetic fitness of prospective partners? Over the past decade, how many Jewish couples who have discovered that their children could be born with Tay-Sachs disease, and black couples with similar concerns about sickle-cell anemia, have opted to forgo marriage altogether? As we uncover genes affecting traits that fall well within the range of normal variability, will these too become the object of prenuptial examination?

Once again, such an Orwellian vision would seem to reach far beyond current realities. Yet nightmares have already occurred. Two decades ago, genetic screening among the population in central Greece for the blood disease sickle-cell anemia revealed a number of normal individuals carrying genes that predispose their offspring to the disease. Because the test results were inappropriately disclosed, these individuals became publicly identified and stigmatized, and formed an unmarriageable genetic underclass.

Along with facing new issues around marriage, young adults with unfavorable constellations of genes may be limited in their employment possibilities. Employers want to hire productive, intelligent people. Will they exploit genetic screening to decide how rapidly a prospective employee will adapt to a new job or contribute to a company's productivity?

Even more likely will be attempts to use genetic markers to predict susceptibility to dangers in the workplace. People have different tolerances to on-the-job chemical exposures, dictated by their genetic variability. There is therefore great interest in uncovering polymorphic markers that would allow companies to predict employees' susceptibility to certain chemicals encountered in the workplace.

Employers will also feel pressure to use the expanding powers of genetic diagnosis to predict lifelong disease susceptibility among workers. The staggering rise in health-insurance costs has already generated strong economic incentives for employers to improve the health of their workers by promoting smoke-free environments, routine medical screening, and healthy lifestyles. Hiring only those people who pass genetic profile tests



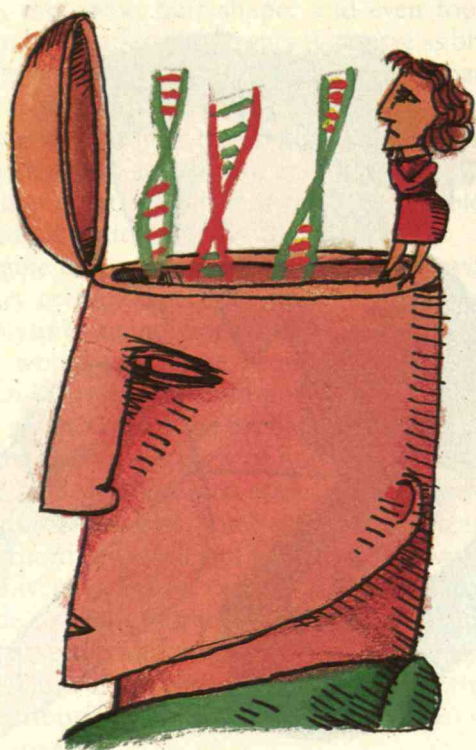
might be seen as a means to reduce health-insurance costs further.

Most employers have until now been unwilling to enter so deeply into employees' private lives. But insurance providers have shown no such reticence. For example, many have been interested in learning whether their insured carry the AIDS virus. Genetic tests predicting heart disease at an early age or susceptibility to cancer will be tempting targets for insurance companies intent on establishing allocation of risk and premiums as precisely as possible. Such logic might dictate that the risks now shared within large insurance pools should be allocated instead on the basis of individual genetic profiles.

Genetic profiles could be widely available by the year 2000, when many primary-care physicians will routinely order certain genetic tests along with the usual blood pressure reading and urinalysis. Overlooking a standard genetic test will increasingly be seen as tantamount to malpractice. And as genetic profiles are routinely entered into health records, limiting insurers' access to such data may prove difficult.

Surely legislation could limit the direct viewing of confidential genetic data by insurers, but they might circumvent even the best attempts at regulation. Imagine the health policy of 2001 that offers substantially reduced premiums to nonsmokers having a desirable

Will genetic studies provide a scientific basis for racism?



genetic makeup. Such incentives will drive many people to flaunt their DNA profiles. As the genetically fit flock to the low-risk, low-premium pool, those left behind will have to pay higher premiums or even forgo insurance. In time, the concept of pooling genetic risk will seem a quaint relic of a pretechnological era.

While these developments are unsettling and even frightening, they pale beside the possibility that our ever-advancing understanding of human genetics could stoke the fires of racism.

Imagine in the not-so-distant future a survey of the prevalence of certain polymorphic alleles among different ethnic and racial groups. Ten years from now, will our enterprising graduate student find a polymorphic marker correlated with acute visual perception that is unusually common among Tibetans, or another correlated with impaired mathematical ability that crops up frequently among coastal Albanians? Given the vagaries of human history and population genetics, it is more than likely that different versions of genes are unevenly distributed throughout the human species.

Will such ostensibly innocent measurements of distributions of polymorphic markers ultimately provide a scientific basis for the type of virulent racism that inflamed Europe a half-century ago? Nazi racial theories were based on a pseudoscience that today looks ludi-

crous. But surely some observed variations in gene frequencies will place solid scientific data in the hands of those with an openly racist agenda.

Beyond Legislation

Policies governing the use of genetic information need to be debated and put in place early in this decade, not after problems emerge. Bioethics is already a thriving cottage industry, but the problems many of its practitioners wrestle with—issues like surrogate motherhood and *in vitro* fertilization—will be dwarfed by those surrounding genetic analysis. The groups organizing the human genome project have already assembled experts to confront the ethical, legal, and social dimensions of this work. But these individuals have yet to plumb the depths of the problems.

Even if we as a society can anticipate and rein in most misuse of genetic data, we will also need to address a more insidious and ultimately far more corrosive problem of DNA profiling: the rise of an ethic of genetic determinism.

For the past century, the prevailing winds of ideology have largely driven the ebb and flow of the nature versus nurture debate. A widespread reaction against social Darwinism and Nazi racism buoyed the strong nurturist sentiments of the past half-century, but the tide is turning, pushed by the ever more frequent successes of genetics. As this decade progresses, a growing proportion of the lay public will come to accept genes as the all-powerful determinants of the human condition. This uncritical embrace of genetics will not be deterred by scientists' reminders that the powers of genetic predictions are limited.

Even some experts who, through appropriate channels, will gain access to genetic profiles may overinterpret the data. DNA profiles will never be clear, fully reliable predictors of all traits. For many complex traits, such as those involved in behavior and cognition, genetics will at best provide only a probability of development. After all, many traits are governed by the interplay between genetics and the environment. Environmental variations can cause genetically similar individuals to develop in dramatically different ways. Interpreters of genetic information who overlook this fact will repeatedly and disastrously misjudge individual ability.

What a tragedy this would be. The world we thrive in was built by many people who were not shackled by their pedigree. They saw their origins as vestiges to be transcended. By and large, we Americans have viewed our roots as interesting historical relics, hardly as rigid molds that dictate all that we are and will be. What will come of a world view that says people live and strug-

DNA and Babylonian Tablets

To find every human gene, scientists will have to determine the sequence of the 3 billion characters in our DNA that together form the genetic blueprint known as the human genome. One can convey how daunting the effort will be by comparing the genome to a Babylonian library uncovered in some nineteenth-century archeological dig.

Imagine tens of thousands of clay tablets—individual genes—scattered about, each inscribed with thousands of cuneiform characters in a language with few known cognates. The library's chaos mirrors the encountered when the precisely ordered array of DNA molecules that is present in a living cell is extracted and introduced into a test tube. Imagine, too, that the library's full meaning will be understandable only when most of its tablets have been deciphered.

Geneticists today have ways

of laboriously sifting through heaps of "tablets" to find certain genes of special interest. Once a gene is located and retrieved, or "cloned," the sequence of its 5,000 or more bases of DNA—our cuneiform characters—can be determined.

While biologists are proud of having sequenced more than one percent of the "tablets" so far, these achievements represent only a piecemeal solution to a very large problem. Gene cloning and sequencing techniques developed in the 1970s are so time-consuming and painstaking that systematic searches for many genes have been impossible.

A better answer, in the form of the human genome project, will begin by mapping the genome—cataloguing all the Babylonian tablets. In effect, geneticists will gather and systematically shelve the scattered tablets, reconstructing their original order.

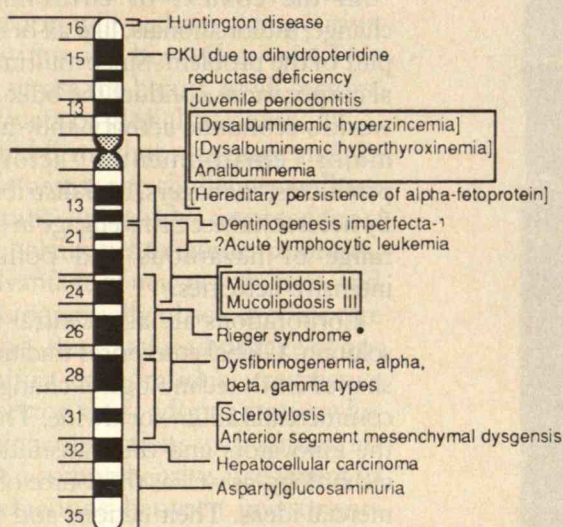
Initially, groups of tablets (DNA fragments) thought to derive from a common section (chromosomal region) of the library will be placed together on a shelf. Then geneticists will order the tablets within a group and give each a label. They will do so without any understanding of the tablets' contents.

How is this possible? Imagine that our Babylonian scribes have used the final phrases at the end of one tablet as the opening phrases of the next one. Short redundant strings of characters would enable tablets to be shelved in the right order without any knowledge of the bulk of the text. Long, carefully ordered lists of the labels identifying individual tablets, in effect a complete library catalogue, will compose the human genome map.

Only after this work is completed can the reading of all the characters in each tablet proceed—the sequenc-

ing of the DNA bases. Great technical progress will be required before that work becomes economically viable. Sequencing a 1,000-base stretch of DNA now costs \$5,000 to \$10,000. And some genes are giants; the one involved in muscular dystrophy was recently found to encompass 2 million bases. The cost will have to drop by a factor of 10 through automation before sequencing can begin in earnest.

Think of the technology required to develop automated readers that could photograph 3,000-year-old tablets, analyze and read the characters with greater than 99 percent accuracy, flag ambiguous ones, and introduce everything into a computerized database. The details of the automated DNA-sequencing equipment under development differ, but the technical problems are no less challenging.—Robert A. Weinberg



On chromosome 4, geneticists have found roughly where the gene for Huntington's disease is. The same chromosome is home to a gene associated

with PKU—which causes mental retardation—and a gene that contributes to liver cancer, technically known as hepatocellular carcinoma.

gle to fulfill an agenda planned in detail by their genes? Such a surrender to genetic determinism may disenfranchise generations of children who might come to believe that genes, rather than spunk, ambition, and passion, must guide their life course.

A belief that each of us is ultimately responsible for our own behavior has woven our social fabric. Yet in the coming years, we will hear more and more from those who write off bad behavior to the inexorable forces of biology and who embrace a new astrology in which alleles rather than stars determine individuals' lives. It is hard to imagine how far this growing abdication of responsibility will carry us.

As a biologist, I find this prospect a bitter pill. The biological revolution of the past decades has proven extraordinarily exciting and endlessly fascinating, and it will, without doubt, spawn enormous benefit. But as with most new technologies, we will pay a price unless we anticipate the human genome project's dark side. We need to craft an ethic that cherishes our human ability to transcend biology, that enshrines our spontaneity, unpredictability, and individual uniqueness. At the moment, I find myself and those around me ill equipped to respond to the challenge. ■



The Global Multinational

BY NAZLI CHOUCRI

THE fact of human intervention in ecological processes is not in doubt. Despite uncertainties and continued controversy, human influences on the global environment appear significant. It is no longer plausible to defer including environmental factors in corporate strategies until scientific consensus is reached.

But among environmentalists and policymakers, the responses to environmental change have emphasized underlying processes such as energy use and population growth, largely ignoring institutions, agents, and markets. This omission could impede innovation and forestall prospects for managing the world's environment.

In the context of environmental change, multinationals, like all of us, are part of the problem. Since multinational corporations conduct the bulk of the world's economic activity, they are the major environmental actors as producers, managers, and distributors. By necessity, these firms engage in a wide range of hazardous and pollution-intensive activities.

Corporations are also central to the solution. Global enterprises traditionally shaped both technological change and commercialization worldwide. They are the innovators and the transmitters of technology, as well as the source of commercial ideas. Their actions and strategies are crucial in determining the environmental landscape. It will be corporations—their technological capabilities and edge—that shape new modes of economic performance.

Indeed, the multinationals will be in the spotlight. They will be subject to na-

Environment & Corporations

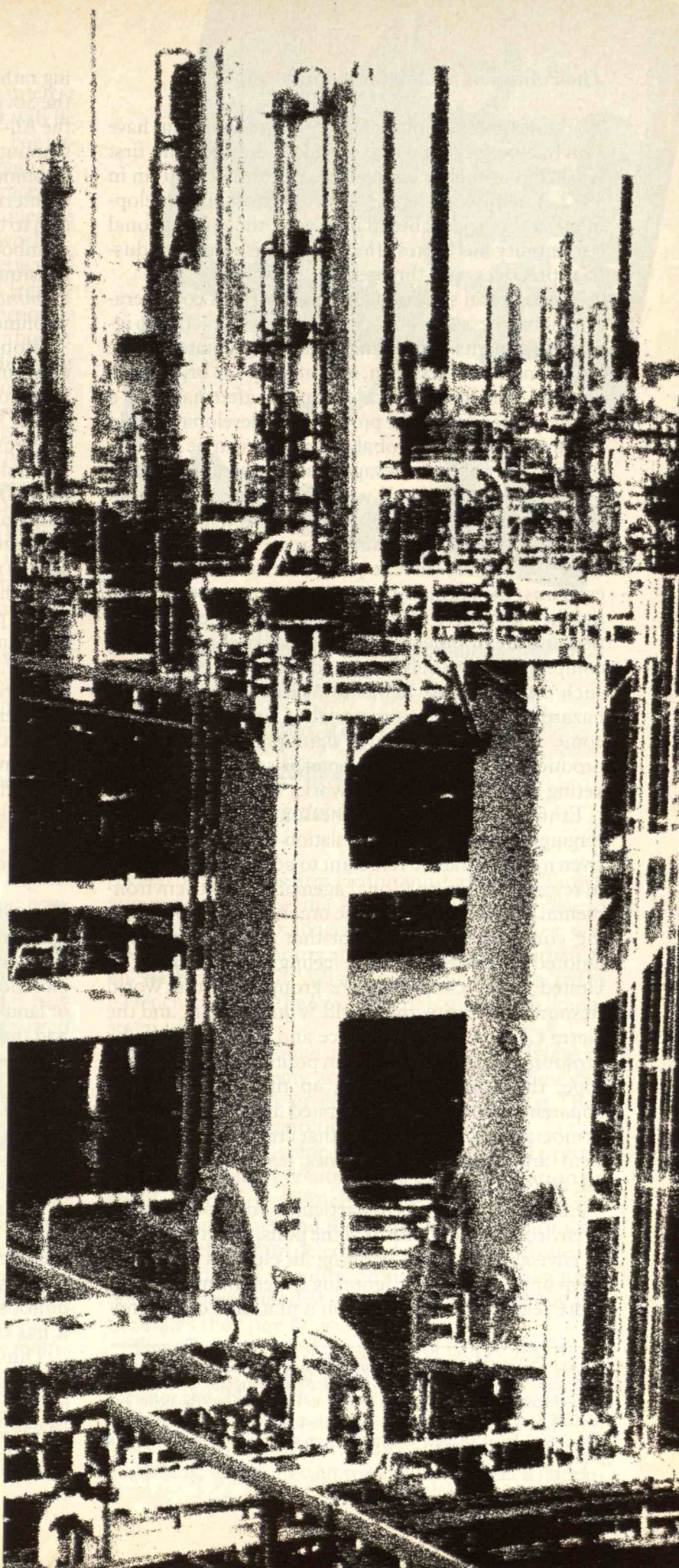
*Global companies
must forge a partnership to
manage the environment.*

national and international regulation as private groups use evidence of environmental mismanagement to pressure governments to limit corporate behavior. An environmental ethos already affects legislation everywhere, and as problematic as regulation, control, and litigation may be, few businesses could withstand an anti-nature reputation and the loss of goodwill.

These factors are transforming the international marketplace. Almost overnight, global companies have confronted concerns well beyond the pale of conventional strategic planning—concerns that were certainly not identified in business school. The question is not whether to respond to the new business context but how; not whether such action will reshape competition but how fast and how effectively. This is true across the board, in all sectors, in all facets of global business.

Global firms that recognize and accurately assess the challenges will see important—possibly unprecedented—opportunities to reorder priorities, take advantage of new possibilities, and reassess potentially obsolete corporate strategies. But to take advantage of opportunities, corporations, irrespective of the sector, must adopt a strategy for managing interactions with nature, including a comprehensive assessment of all interactions between investments and the environment.

To the extent that firms act voluntarily, they will maintain an advantage. To the extent that environmental practices must be regulated, legislated, and controlled, companies will find themselves on the defensive.



The Politics of a Global Environment

The contours of a global environmental consensus have slowly emerged over two decades. Between the first world environment conference, held in Stockholm in 1972, and the conference on environment and development, to be held in Brazil next year, the international community has been stiffening its resistance to industrial practices that threaten the biosphere.

While moral suasion is hardly a serious consideration in business decisions, it can be poor practice to ignore sentiments that define what is legitimate. As the Valdez incident has shown, no company can brush aside outrage. The Bhopal accident and its aftermath add a further dimension to the problem: the developing world is learning that even global companies can be held liable in a court of law to a vague environmental morality.

Moreover, traditional ways of viewing the international business environment—nations, borders, markets—blur as degradation crosses borders, transmitted by winds, currents, and other natural processes. Thus, the entire theory of international corporate liability is subject to revision as issues of compensation and environmental protection take shape. Parent-company liability may be extended in a variety of ways, such as requiring firms to warn against risk of hazardous activities or materials. Companies may become liable for defective, damaging, or polluting products by any part of the enterprise, including marketing and distribution networks far away.

Ethos, environment, business, and policy are converging as environmental legislation becomes the norm. Even nations that are reluctant to act are being pushed to respond by international agencies, private environmental groups, and scientific organizations. Developing countries such as Egypt that have traditionally ignored the environment are feeling that pressure. The United States cannot ignore groups like the World Resources Institute, the World Wildlife Fund, and the Sierra Club, while Greenpeace and others have had a profound impact on European politics. In Eastern Europe, the need for cleaning up the environment is apparent—the pollution generated under efficient (and democratic) conditions, like that created under inefficient (and authoritarian) regimes, reinforces the emerging consensus.

European countries in particular are showing signs of environmental concerns at the polls, and it is difficult to envisage any party winning an election on a platform opposing or even ignoring the environment—or, more relevant for business, on a platform of expand-

ing rather than restricting corporate activities. Even in the Soviet Union, five major "green fronts," including the All-Union Movement of Greens of Komsomol, the Communist Party's youth organization, combine environmental concerns with opposition politics.

International forums also reflect this growing attention to the environment. Incontrovertible proof of this is embodied in formal efforts—such as the World Commission Report of the U.N. General Assembly, *Our Common Future*—to devise a global strategy for environmental protection.

Global firms simply have no easy way around the emerging ethos, since environmental degradation derives from diverse and legitimate sources. For example, energy is crucial and carbon emissions are ubiquitous. There is a fundamental tension—even war—between technology and ecosystems. In reality, then, "environmentally benign" means less damaging rather than not damaging, and good business demands forthright recognition of this fact. Global corporations can at best seek to mitigate the most severe effects of pollution and to channel the others in an acceptable direction.

The political givens create the criteria for realistically assessing profit possibilities. Three types of global corporation—the oil, chemical, and construction industries—illustrate the basic dilemma: almost any action generates environmental effects that can only be reduced, managed, minimized, or contained. These three industries show different aspects of ubiquitous environmental degradation, and all confront the inevitability of major corporate response.

The Oil Industry: Responding to Market Signals

The oil industry was long insulated from any constraint—from governments or the public. The near-total absence of environmental codes in overseas exploration and development—let alone transport by ship or land—gave the industry free rein. No one, anywhere, had the power to seriously limit the ecological consequences of petroleum extraction, production, processing, or transport. Not until the price shocks of 1973 did the industry feel any significant limitations.

That has changed. The public has become concerned about such mishaps as spills, which are inevitable in transporting oil. The Valdez incident can't be dismissed as an unfortunate and inadvertent oversight. In the United States, a spill occurs each day on average, and the number is rising. The object is not to assign responsibility—moral or legal—but to show how ubiquitous environmental degradation is and how salient it has become as a business factor.

Thus, the U.S. oil industry is coming under growing scrutiny from both public authorities and private groups. In other countries, the process is much slower—it is difficult to imagine Saudi or Venezuelan authorities considering environment relevant to

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petroleum—but already private and public interest groups are pushing for action. The argument will be made that the numbers speak for themselves. For example, the Persian Gulf states have remarkably high per-capita carbon emissions, a fact that can be traced to both an energy-intensive lifestyle and the consequences of hosting large-scale oil operations for the world.

Global oil enterprises may find themselves engaged in public-relations wars with potentially high legislative and regulatory stakes. The hazards to corporate bottom lines are obvious: everyone knows that higher environmental standards will bite into profits. But what opportunities will the oil industry find? Exxon, Texaco, and Chevron, among others, have charged remarkably high environmental costs against profits—an inevitable new fact of corporate life. Phillips Petroleum's donation of \$625,000 over five years to preserve wetlands in the Southwest may be more prophetic of things to come, with environmental strategies including preventing damage as well as repairing it. And Conoco, a subsidiary of Du Pont, has ordered two double-hull tankers designed to reduce the chances of spills, a radical departure in this industry.

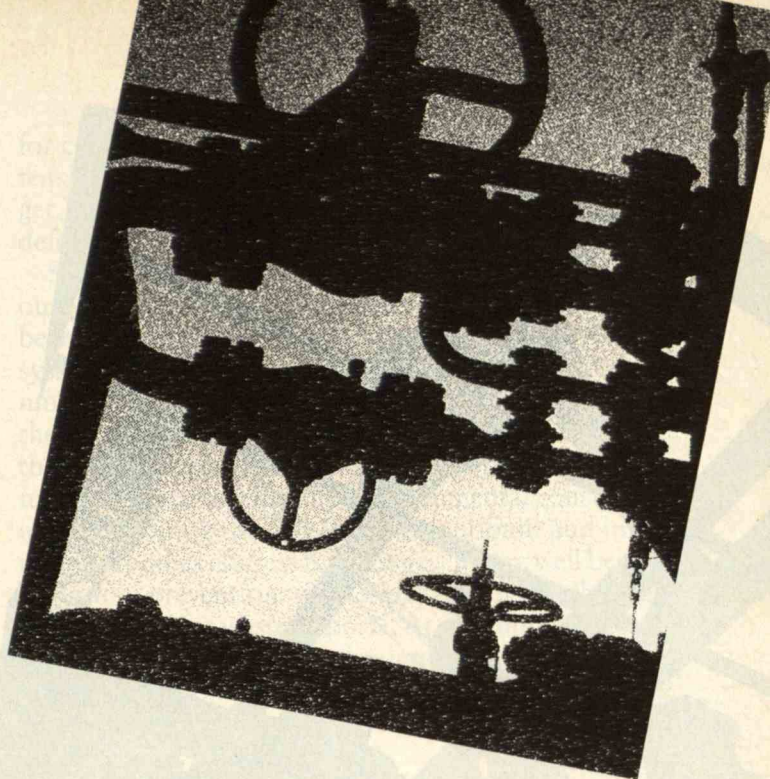
There are business opportunities beyond those for public-relations firms and clean-up technology. These involve creating and shaping markets at the technological frontier in each phase of the oil industry—from exploration to transportation and utilization. Both on-the-shelf and beyond-the-horizon technologies could play a role.

Will such moves reshape the competitive arena? In retrospect, the petroleum industry has generally responded to market signals—for example, by exploring new kinds of contracts when the negotiation power of host countries has grown. In the same manner, voluntary environmental codes and guidelines developed by the industry could preempt the most demanding legislative constraints. A preemption strategy may be especially valuable if the industry is to protect itself from legitimate charges of irresponsibility.

The Chemical Industry: Technology's Dual Role

Like oil, the chemical industry faces ubiquitous environmental problems, but global chemical companies are positioned more precariously with respect to the environment: they are already subject to international regulations sanctioned by formal intergovernmental agreement.

One reason is that accidents like that in 1984 at Union Carbide's Bhopal pesticide plant have dramatized the potential environmental consequences of the industry. Bhopal drew attention to the wide span of hazardous chemical operations and highlighted Union Carbide's weak environmental protection policies. In a business climate already strained because of a massive 1976 chemical explosion at a factory in Seveso, Italy,



The involvement of Du Pont and other chemical companies in negotiations over CFCs shows that technological innovation is dual-edged. It can both generate hazards and yield less hazardous alternatives.

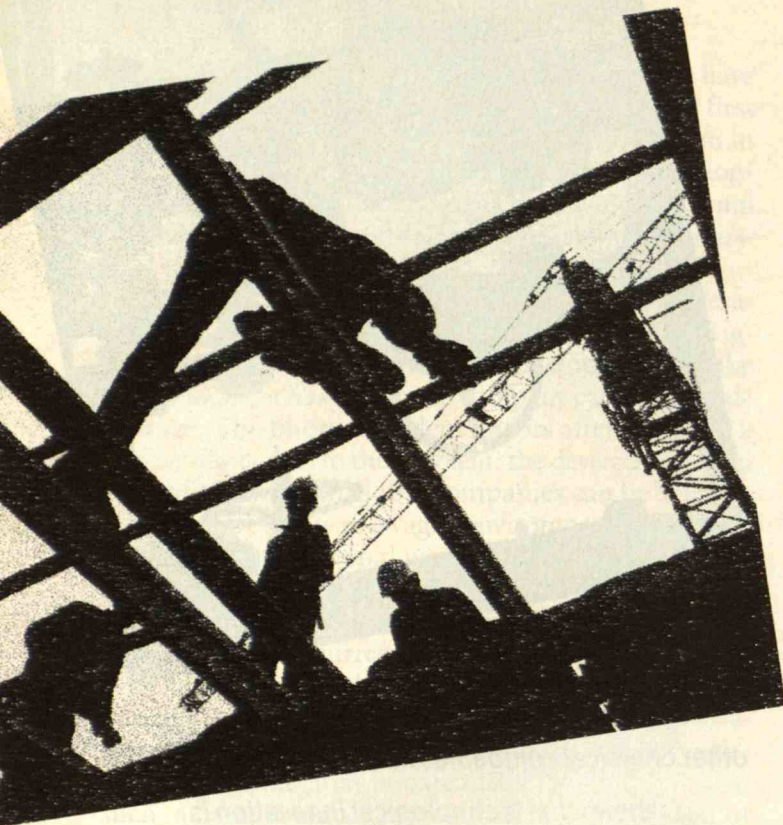
owned by the Swiss firm Hoffmann-La Roche, Bhopal augured poorly for the whole industry. The Seveso blast, grossly mismanaged by Italian authorities, was only reported 27 hours after it happened, and then as an "herbicide cloud." Waste disposal was contracted to a French firm, and the toxic materials surfaced in France seven years later.

Chemical companies are also essential to solving environmental problems, and they are by far the most visible multinationals in deliberations to do that. Two instances of regulation illustrate both trends.

In March 1989, some 93 countries attended negotiations for the final version of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. This protocol, which resulted from determined pressure by private environmental and scientific groups, attempts to govern both the companies that generate hazardous wastes and the states they pay to accept the materials.

The effectiveness of the protocol is less important than the effort itself to place limits on the free market. Neither the "buyer" nor the "seller" is totally free to exchange hazardous materials. Both are bound by an agreement to which neither may have been a party.

Already, nearly 50 countries have established nation-



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al legislation regarding the hazardous-waste trade, and the Basel Convention binds most of them at the global level. Such agreements could give multinationals less flexibility in locating their activities, compromising the ability to rapidly shift production from regions with high environmental standards to those with low ones.

The Basel Convention is a natural outgrowth of market conditions in some ways. The number of countries that import or export hazardous waste has grown markedly over the past decade. About 3 million tons of toxic waste cross European boundaries annually. West Germany exported its wastes to East Germany, and the Federal Republic now finds itself in the anomalous position of having to clean up these same sites. And while efforts to handle hazardous-waste problems at first focused on reducing exports to developing countries from industrial nations, the transport of wastes among industrial states is also extensive.

The United States alone sends about 80 percent of its waste to Canada and Mexico. Great Britain has continually increased its imports of hazardous waste. All of this complicates the simple view that it is always rich nations dumping on poor ones.

The chemical industry has faced regulation to control ozone-depleting CFCs as well. While industrial societies are the principal consumers of CFCs, exports to developing countries are coming under scrutiny with or without the participation or consent of potential "buyers."

The 1987 Montreal Protocol to reduce CFC use is global both in recognizing a class of environmental problems and in establishing the need for worldwide efforts to resolve them. In 1990, the protocol was revised and more countries signed it, suggesting an expanded role for intergovernmental agreements of this sort.

The Montreal Protocol is part of an evolving framework for managing environmental degradation. This framework will render investments and strategies subject to scrutiny and make firms partners—willing or otherwise—in global management. Global corporations will have to deal with pressure from private and public environmental interests. Already consumers, companies, and governments are trying to bargain, and issues of technology transfer, cash transfer, and other forms of compensation are taking shape.

Private groups are more central to CFC talks than they were to the negotiations for the Basel Convention. The participants in the informal but critical discussions leading to the Montreal Protocol included 55 states and many transnational public interest groups and scientific organizations, as well as formal regional and international institutions and chemical companies, notably Du Pont. The signatories were governments, to be sure, but the participants in the emerging bargain varied in size, interest, representation, national jurisdiction, and institutional affiliation. In this respect, the protocol is unprecedented. Chemical companies can neither ignore nor control that alignment of interest. It consists of too many parties that, in the aggregate, are too influential.

As CFCs show, technological innovation is dual-edged: it can both generate hazards and yield less hazardous alternatives. For example, a joint venture between Du Pont and Merck, announced in July 1990, presages business as well as environmental opportunities in the chemical industry. Merck, the world's largest pharmaceutical company, has a reputation for environmental responsiveness. Du Pont and Merck could jointly develop a strategy to influence regulatory standards for the chemical industry worldwide. If they do not, others will do it for them.

Whatever the outcome of efforts like that of Du Pont and Merck, the odds are excellent that growing con-

cern for codes, protocols, and environmental responsiveness makes the search for places with lax laws difficult if not impossible. The result will be something of a level playing field, with global companies all subject to similar constraints. Under these conditions, only a foolhardy CEO would ignore environmental issues.

The Construction Industry: A Global Future

The construction industry's dilemma is in many ways even more severe. The problem is this: building physical structures invariably means dislocating natural systems. All facets of the industry clash with nature—from harvesting building materials to site preparation, transportation, actual construction, and the disposal of residual materials. Dislocations cannot be avoided; at best they can be managed.

In industrial societies, construction has already changed the environment in major ways. Here the challenge is to repair, upgrade, and expand structures without significantly altering the environment further. But for developing countries, the problem is just beginning, and it is in these markets that the industry envisages its most extensive expansion. A 1977 Bechtel memo on "international job strategy" suggests five countries in which "business-development positioning should begin or be intensified"—Nigeria, Malaysia, Algeria, Indonesia, and Iraq.

However, construction firms with Bechtel's scope are rare. Unlike the oil industry, construction has traditionally been local, tied to local investments. Even so, today's technology and resource needs, managerial skills, and corporate strategies all lead toward globalization. And while global construction corporations have yet to encounter the legislative, political, or moral constraints of the environmental ethos, it is inevitable that they will. A recent "Bechtel Briefs" lists such business problems in Taiwan as a labor shortage and clogged roads, but goes on to note that "it is perhaps environmental neglect that causes the greatest anxiety."

International environmental groups are already braced for encounters with global construction. In the confrontation between those who desire to build and those who oppose it, the governments of developing nations will be in an anomalous position: they must develop their infrastructures but can't be viewed as declaring war on nature.

These governments are already beginning to see some way out by exploring the bargaining possibilities inherent in environmental protection. For example, a wide range of debt-for-nature swaps are reducing the burden of past financial commitments and may free resources for meeting more immediate social needs. Similarly, nature-for-technology swaps may be negotiated to facilitate access to less polluting technologies. This is especially important in energy, where the potential

for conservation and more efficient technology is extensive. In developing countries, such efforts may target reducing both carbon emissions and the rate of deforestation.

Still, the construction industry has yet to think seriously about the environment, remarkable as that may be in an industry whose purpose is to transform natural systems into built ones. But the environment clearly must become a salient factor in strategic planning for the construction industry in the very near future. Like the oil industry, construction faces important opportunities for staying ahead of environmental constraints and for shaping the way in which national and international bodies address these issues. It may well be that pollution prevention would pay for itself through reduced need for waste disposal. At a minimum it could reduce liabilities. Bechtel subsidiaries are working with Taiwan's Environmental Protection Agency on projects ranging from solid-waste disposal to noise abatement.

Implications for Multinationals

If a firm is to compete, it cannot misread the signals of the global environmental ethos and conduct "business as usual." But while governments, public interest groups, and international organizations are searching for institutional innovation and adaptation in this area, global corporations, with few exceptions, have generally failed to develop an environment strategy.

This must change. The crystallization of moral suasion means that companies must pursue technological opportunities aggressively. Scarcely anyone, anywhere, defends unrestricted growth and development regardless of the consequences. The chemical industry's disposal of hazardous material is coming under scrutiny. Oil spills are in the spotlight. In construction, attention has focused particularly on hazardous materials and damaging landfill practices.

With the public demanding accountability and greater government intervention in the offing, how will each industry manage potential embarrassments? How can firms minimize, manage, or channel government intervention? And most pressing of all, how will they take advantage of the changing business environment?

First, global firms must be environmentally responsible over the long haul; this can't be viewed as a posture of convenience or as a way to maximize short-run profits. Since agreements like the Basel Convention and the Montreal Protocol are flexible instruments—with built-in mechanisms for adjustments as science provides more clues—there will be more, not fewer, constraints. Multinationals will be able to respond only if they have a responsible technology strategy.

The marketing challenge, once limited to identifying a product, now extends to explaining what a company will do about the environmental consequences of



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its activities. Managing an inquisitive and possibly hostile public must be part of maintaining a positive image, but public relations without environmental action will surely backfire. So, too, positive action without realistic public relations may be a disadvantage.

Global corporations must further recognize how environmental concerns can help business. One case is Du Pont's accelerated R&D on replacements for CFCs, although this is an interim measure and won't buy goodwill for Du Pont for long. In the oil industry, Norske Hydro is making a strong claim for sound environmental management, and it also enjoys some of the goodwill accruing to Norway for its sensitivity to the environment. Goodwill is a solid business asset.

Firms might identify appropriate environmental niches as well. For example, World Envirotech, a U.S. subsidiary of the Kubota Corp. of Japan, has found a niche in offering to dispose of refuse left after treating sewage. Adopting an aggressive approach to marketing waste-treatment technology in the United States, World Envirotech creates opportunities and reaps goodwill.

How rapidly a firm understands and addresses the changing norms and values regarding the environment will define in part its competitive edge. Companies must decide whether they will impede or preempt, prevent or participate in international efforts to develop effective global environmental strategies.

A Corporate Consortium for the Environment

It is obvious that environmental considerations affect almost all aspects of global enterprises. Retaining a competitive edge under the environmental gun will be a formidable challenge.

The "soft technologies" of management must be improved, updated, and tuned. Industry will continue to be on the defensive unless it buttresses environmental management and corporate organizational charts reflect environmental priorities. Risk assessments and contingent responses to hazards must be routine. Exxon's appointment of a senior staff member as corporate vice-president for environmental issues is a step in the right direction. However, cost-cutting in the petroleum and petrochemical industries has reduced managerial skills in the environmental area. Exxon has 10 fewer senior environmental experts than in the 1970s. Combined with a shift to contracting environmental cleanups to outside firms, this dilutes Exxon's managerial ability.

With large multinationals uniquely positioned for framing public policy, a good offense may be the best defense. Shaping public policy is good business—providing it is done with a modicum of ethics. Unless the multinationals discuss a strategy for influencing policy, they will be reduced to responding directly to outraged citizens. The legal implications are obvious

*A corporate consortium
on the environment would help level the environmental
playing field and keep competition on technology,
management skills, and creating
and shaping markets.*

and the precedents for cross-jurisdictional litigation numerous. Developing networks for access to specialized services in environmental products and processes may reduce both the risk and the pain for all firms. New alliances may also force governments to make regulation rational.

Under these circumstances, the case for establishing a "corporate consortium on the environment" seems powerful. While no two companies are identical, none is unique. A consortium for exchanging information, streamlining the costs of responsible environmental action, and establishing a forum for policy deliberation would help corporations develop the best strategies.

The goal of a consortium would be to help level the environmental playing field and keep competition where it should be: on technology, management skills,

and creating and shaping markets. In the case of environmental concerns, the shared predicaments outweigh by far the idiosyncratic risks. The rules of global investments are changing, and it is in the joint interest of global firms to make the new rules provide the best market. Because markets function efficiently and serve social objectives only given stable and well-understood norms, corporations must strive to help steer global deliberations toward clarity and consistency.

In essence, multinational corporations must enter into a partnership with nature. The world needs corporations to help arrest environmental deterioration; the corporations need to address environment factors to compete effectively. Preserving the planet's natural assets could become sound business practice as surely as it is already excellent public relations. ■

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A PHOTO ESSAY

Coral Grief

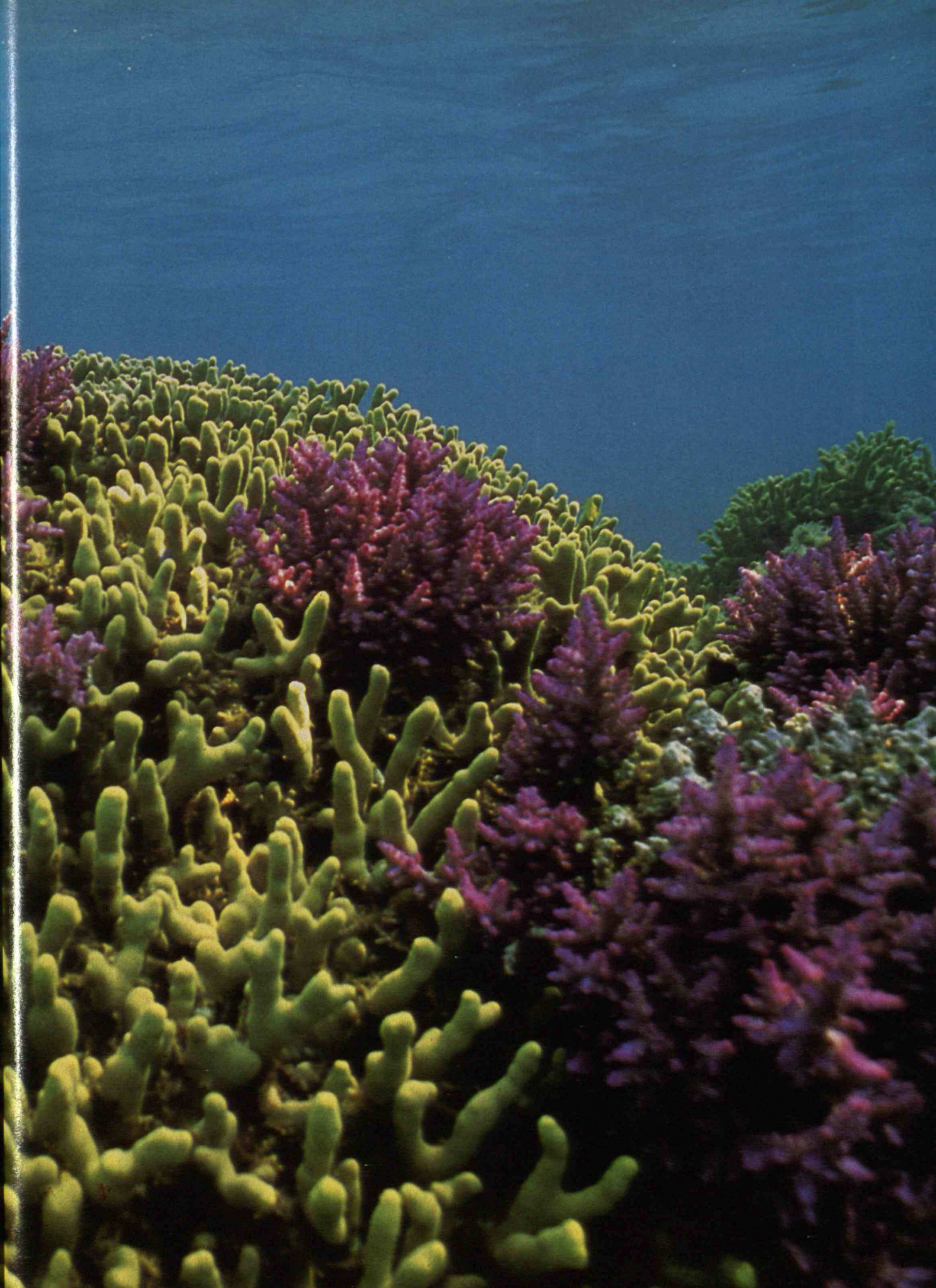
BY KATHERINE MUZIK

ONLY tropical rainforests rival living coral reefs in the numbers of plants and animals that coexist. Yet people have long taken coral reefs, most of which are more than 10,000 years old, for granted. Now growing numbers of marine scientists are viewing the condition of these elements of tropical paradise with alarm. Many researchers say human activity is endangering reefs from Japan to the Caribbean, from Kenya to Australia. The sensitivity and importance of corals result from their biology. Fragile, minute animals called polyps secrete skeletal homes of calcium carbonate that mass together to form reefs in warm shallow seas. Coral reefs, which accrete less than a millimeter a year, provide shelter for numerous forms of marine life, many of which in turn become the food supply for other creatures. Reefs have long been important to human populations on nearby land as well, not only by providing food such as fish but by acting as natural, self-renewing barriers to pounding waves.



Local Japanese (above) net fish daily from the crest of Shirabo reef (right), a 3-mile-long area that is home to more than 300 species of fish. The presence of a living reef has insured a food supply and storm protection necessary for human culture to develop.







A

Today human activities are taking their toll in many of the areas corals inhabit.

As tourism skyrockets, especially in the Florida Keys and the Caribbean, damage from boats and divers is rising. The practice of stunning fish with blasts from dynamite and other explosives is wreaking havoc in the seas off southeast Asia and the Philippines. Off Moruroa, an atoll near Tahiti where the French test nuclear weapons underwater, Greenpeace has detected radioactive contamination in plankton and is now testing plankton-feeding corals. Marine biologist Yossi Loya of Tel Aviv University has reported, based on work in the Red Sea, that oil spills can damage the reproductive and nervous systems of coral polyps. Along Japan's subtropical island chain, soil from agricultural runoff and sediments from the construction of ports, bridges, and airports has suffocated entire sections of reefs. Other forms of pollution, including sewage, fertilizers, and pesticides, are also creating problems around the world.

A coral reef in Iriomote National Marine Park in Japan's Okinawan Islands, thriving in 1973 (A), fell prey to crown-of-thorns starfish later that decade. Corals often regenerate soon after starfish predation, but in this case almost nothing had grown back by 1983 (B). The author found conditions un-

changed in 1988. The lack of regrowth probably stems from agricultural sediments and other environmental stresses. The beauty of a branch of living polyps contrasts starkly with one that has died (C and D). Below: Coral reefs are found worldwide.



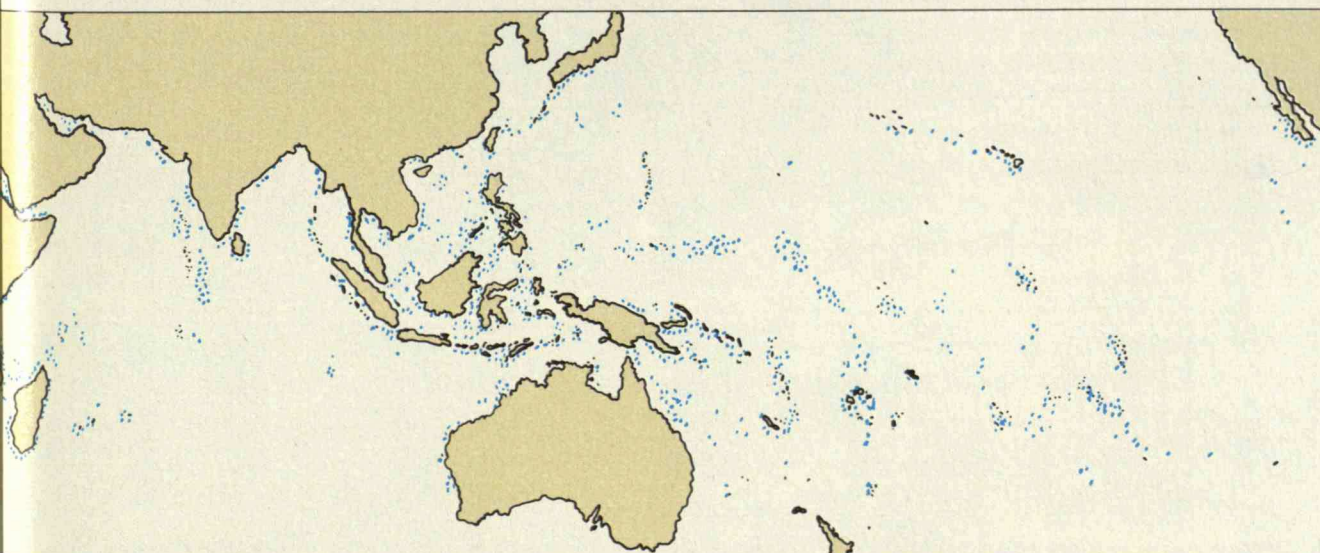


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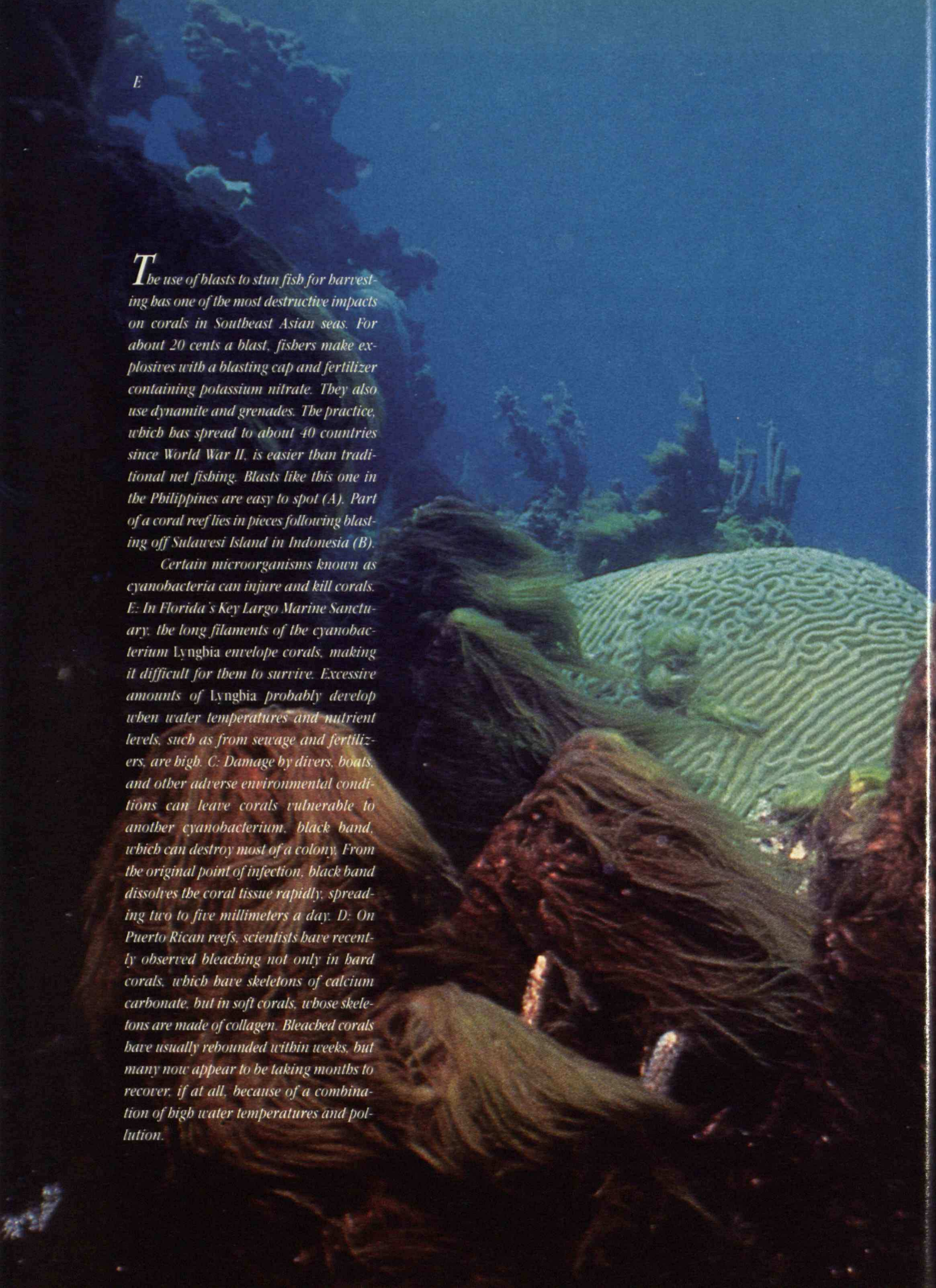
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PHOTO CREDITS: PAGES 60-61 Tomoo Kobashigawa; PAGES 2, 62-63: Zenji Yoshimine; PAGES 64-65: Lynn Funkhouser, James Maragos, Harold Hudson, Lucy Bunkley-Williams, John Halas; PAGES 66-67: Tomoo Kobashigawa, James Maragos, Zenji Yoshimine.



The use of blasts to stun fish for harvesting has one of the most destructive impacts on corals in Southeast Asian seas. For about 20 cents a blast, fishers make explosives with a blasting cap and fertilizer containing potassium nitrate. They also use dynamite and grenades. The practice, which has spread to about 40 countries since World War II, is easier than traditional net fishing. Blasts like this one in the Philippines are easy to spot (A). Part of a coral reef lies in pieces following blasting off Sulawesi Island in Indonesia (B).

*Certain microorganisms known as cyanobacteria can injure and kill corals. E: In Florida's Key Largo Marine Sanctuary, the long filaments of the cyanobacterium *Lyngbia* envelope corals, making it difficult for them to survive. Excessive amounts of *Lyngbia* probably develop when water temperatures and nutrient levels, such as from sewage and fertilizers, are high. C: Damage by divers, boats, and other adverse environmental conditions can leave corals vulnerable to another cyanobacterium, black band, which can destroy most of a colony. From the original point of infection, black band dissolves the coral tissue rapidly, spreading two to five millimeters a day. D: On Puerto Rican reefs, scientists have recently observed bleaching not only in hard corals, which have skeletons of calcium carbonate, but in soft corals, whose skeletons are made of collagen. Bleached corals have usually rebounded within weeks, but many now appear to be taking months to recover, if at all, because of a combination of high water temperatures and pollution.*





A



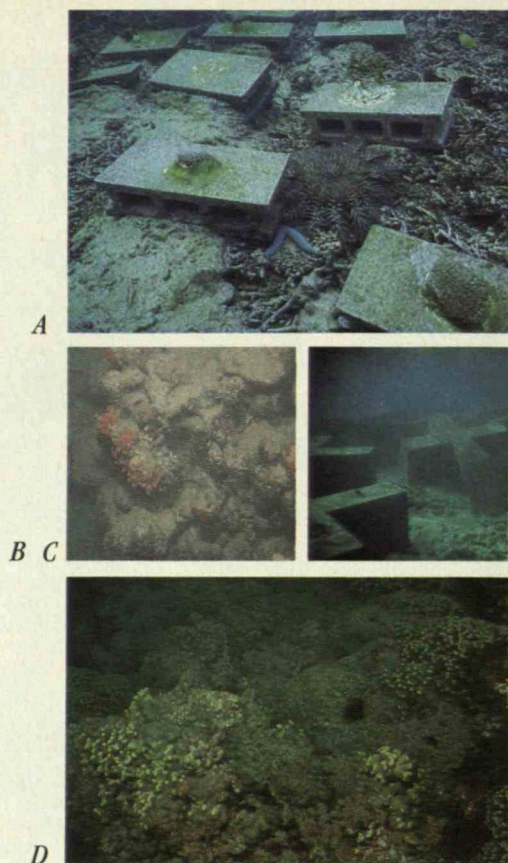
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Can technology help? The Japanese government provided more than \$200,000 to scientists at the University of the Ryukyus in Okinawa to study coral transplantation. But in 1985, three months after the researchers attached corals to cement blocks, many of the specimens had slipped off, and sediments and starfish had killed others (A). By 1989, four years later, less than 10 percent of the corals had survived. Silt smothered corals in Apra Harbor, Guam, (B) despite underwater curtains used during dredge-and-fill operations for a new U.S. Navy wharf. Faced with the loss of coral beds that once provided homes for lobsters, Japanese engineers unsuccessfully attempted to attract lobsters to cement "houses" (C).

Coral may best be saved by altering human activity. In 1975, green bubble algae were smothering coral beds in Kaneohe Bay in Oahu, Hawaii (D). But corals regrew substantially after the late-1970s diversion of sewage previously dumped in the bay. Coral growth remains high today, despite a resurgence of algae caused by an as-yet-unidentified source of nutrients. Right: Shiraho reef off Ishigaki, Japan

The cause of some damage to coral reefs remains elusive. Consider, for example the numerous events of "bleaching" recently reported among reefs worldwide. Corals turn a ghostly white and lose living tissue following the collapse of the symbiotic relationship between polyps and their resident single-celled plants, called zooxanthellae. Until 1987, marine scientists considered bleaching an isolated problem stemming from local water pollution or natural fluctuations in water temperature. But bleaching occurred across the Caribbean that year, and again in 1989 and 1990. Marine biologist Thomas J. Goreau, who recently spoke at a Senate subcommittee hearing on the subject, links the growing frequency of coral bleaching worldwide with unusually high water temperatures.

If seawater temperatures near coral reefs increase, as part of a global warming trend, they could spell death for coral reefs, says zoologist Marjorie Reaka-Kudla of the University of Maryland. As more corals died, the amount of calcium carbonate fixed from the ocean would drop, while the amount released from the eroding skeletons would rise. This might cause problems since, Reaka-Kudla says, "Living coral reefs definitely represent a large and long-term carbon trap. We don't yet know what the net effect would be." ■

KATHERINE MUZIK, a marine biologist specializing in corals, is a research associate at Harvard University. She spent seven years studying environmental problems in the Okinawan islands of Japan and working to save Shiraho reef, one of the country's last prospering reefs, from a planned airport.



Grime and Punishment

I have recently been intrigued by the story of Evelyn Frank, a 75-year-old owner of companies that haul sludge and petroleum products in New York Harbor. Known in maritime circles as the "Dragon Lady," Frank has for more than two decades been illegally dumping sludge, acids, and other pollutants.

The saga came to public notice when one of Frank's barges sank in the harbor, spilling 40,000 gallons of oil. Coast Guard officials found that the barge had been denied a permit because its hull was deemed too weak to carry oil safely. Investigations revealed that a number of interlocking corporations controlled by the Frank family owed more than \$1 million in fines, taxes, and judgments because of criminal dumping. Frank was made to pay additional fines and was sentenced to five years' probation. Had she been younger, said the judge, she would have gone to jail.

Other violators of environmental laws have indeed gone to jail. Two owners of carting companies recently began 13-year sentences for improperly operating a Staten Island landfill. They had surreptitiously mixed thousands of tons of asbestos and infectious waste from hospitals with the "clean" construction debris that the site was licensed to receive. A fellow defendant, who had given testimony at a state environmental hearing, was not present for the trial, having been shot to death one morning while leaving his house.

The media and the public savor these stories, reminiscent as they are of frontier lawlessness and Prohibition-era escapades. But criminal pollution is becoming a dire problem. It is all very well for ethicists to expound on the need for engineers to protect the public interest. It is admirable for government to legislatively safeguard the purity of our air, water, and soil. But it is absurd to pass new laws while cutting back on the budgetary resources needed to make these laws effective. To what avail are noble intentions and exemplary legislation if we lack the will to enforce them?

Ironically, the stricter we make our an-

tipollution regulations, the more alluring we make the enterprise of waste disposal to criminals. Most corporations abide by the law, however grudgingly. But criminals move in precisely where illicit profits are the most lucrative. Legitimate businesses, which do not usually benefit from the crime, sometimes naively assume that their waste-disposal contractors are obeying the law.

Once we acknowledge that the solution is not to be found in an accumulation of well-intentioned laws, we are faced with the question of what to do next. As one step toward the solution, we should apply political pressure to obtain funding for government agencies so they can hire more inspectors and otherwise enforce the regulations they are charged to administer.

Although good things are happening in the voluntary sector, there, too, resources are not equal to the need. In

tently into the waste disposal enterprise, such citizen groups will be hopelessly overmatched. In a somewhat similar situation—the effort to interdict the flow of illegal drugs—the military has been asked to help. Congress has approved funds to deploy a network of radar-carrying balloons across the southern United States and for AWACS airplanes, outfitted with sophisticated radar, to fly regularly over the Caribbean. Perhaps the Pentagon could be pressed into environmental service as well—not only for monitoring global changes, as suggested recently by Sen. Sam Nunn, but also to enforce pollution laws.

While political approaches to the problem are being debated, engineers might well turn their attention to technical methods of detecting and foiling the pollution outlaws. Another engineering strategy lies in devising ways to cut the cost of acceptable disposal, there-



North Bergen, N.J., a citizen posse, sanctioned by the town, patrols the community issuing summonses to illegal dumpers. On a national scale, the Izaak Walton League has enlisted more than 3,000 "stream watchers" who demand that regulatory agencies act when water pollution comes to light. Citizen-manned boats funded by public-interest organizations patrol the Hudson River, Long Island Sound, the Delaware River, Puget Sound, and New York Harbor. The Clean Water Act and many other laws provide for the legal costs of watchdog groups that bring suits against violators.

But as organized crime moves more in-

by making the enterprise less attractive to criminals.

In tackling environmental problems, all of us—not least engineers—have failed to take into account lessons we should have learned from history. As George Washington wrote: "We have probably had too good an opinion of human nature. . . . Experience has taught us that men will not adopt and carry into execution measures the best calculated for their own good, without the intervention of a coercive power." ■

Samuel C. Florman, a civil engineer, is the author of The Existential Pleasures of Engineering, Blaming Technology, and The Civilized Engineer.

Squeezing the States

FOR much of the last 15 years, state and local governments have acted as technology's benefactors. Governors and legislatures have established R&D centers, instituted financial incentives for high-tech entrepreneurs, upgraded their schools' science and math education, and set up programs to retrain blue-collar workers for information-age professions. But short-sighted decisions at the federal level are imperiling these admirable efforts.

Because of the U.S. government's abandonment of revenue sharing, followed by the drastic cuts in tax rates in 1986, and now the recession of 1990-91, state and local governments are reeling. More than half face budget deficits that force them to contemplate spending cuts in everything from health care to local economic development to cleaning up their air and water.

Federal investment in social capital—from schools to roads to airports to hospitals to training programs—has been declining since its peak in the late 1970s. President Carter eliminated the practice of sharing federal revenue with the states. President Reagan canceled revenue sharing with the nation's cities, as well, ending the experiment in "fiscal federalism" that had begun under Nixon. Since the late 1970s, the proportion of state and local revenues coming from Washington has fallen from 25 percent to about 17 percent, according to the Advisory Commission on Intergovernmental Relations.

The federal government's retreat has left governors, mayors, legislatures, and city councils to fend for themselves in their attempts to get services to a broader mix of citizens. At the same time, they have faced new needs not even imagined a generation earlier, such as guarding and cleaning up the environment and subsidizing foreign companies interested in basing operations in the United States. From 1981 to 1990, state and local spending on everything from housing, health, and training to bridge repair and schoolbooks grew by well over 50 percent in inflation-adjusted dollars.

As a result, many states and localities raised tax rates, fees, and property assess-

ments. Along the way, they launched a number of innovative programs in such areas as economic development and education.

But the golden age of state and local initiatives could not last. The losses of federal grants and revenue were bad enough. But the tax reform act of 1986, which radically cut tax rates, delivered an even more devastating blow. Since elements of most state tax systems are tied to Washington's, and since local governments depend for most of their revenue on higher levels of government (and are in any case severely limited in their freedom to tax businesses within their borders), the result by Christmas of 1990 was a snowballing of shortfalls and budget deficits in jurisdictions all across the country.

To make matters worse, the "real" economy is staggering into the long-awaited recession. Every region's financial and real estate industries are in deep trouble. There

slow growth in the population and hence in total national income, higher revenue can come only from higher tax rates. Without higher tax revenues, the public sector cannot, in the long run, expand. And if you want a higher quality of life, you must have a judicious mix of public and private goods and services.

Those who think we have too much government already might look at how the United States compares with other industrialized countries. In Sweden, nonmilitary public spending accounts for 61 percent of GNP; in what we use to call West Germany, the figure is 45 percent. Even Japan, that bastion of corporatism, devotes 32 percent of its GNP to government. In the United States, by contrast, less than 30 percent of our civilian GNP shows up as nonmilitary public spending.

So long as we continue to commit ourselves to high levels of military spending, the nation's insistence on low tax rates



is severe excess capacity in computer manufacturing as well as in office-building rental space. And if not for the Japanese "transplants" there would be hardly any new jobs at all in such basic manufacturing industries as steel and automobiles.

The recession will, of course, end. But even when growth resumes, state and local governments are in for a hard time. For the foreseeable future, the U.S. government will be unable to assume a larger share of the burden of paying for services or to shift more resources to the states and localities.

The reason is that federal tax rates have fallen to an unrealistically low level. With

threatens to obstruct progress in a number of critical areas, from cleaning up the environment to sheltering the homeless to retraining workers. But then, as David Stockman told us a decade ago (even while he was still the president's chief budget officer), that might just have been the real goal all along. ■

BENNETT HARRISON is a visiting professor of political economy at Carnegie-Mellon's School of Urban and Public Affairs while on leave from MIT's Department of Urban Studies and Planning. His latest book, coauthored with Barry Bluestone, is The Great U-Turn: Corporate Restructuring and the Polarizing of America.

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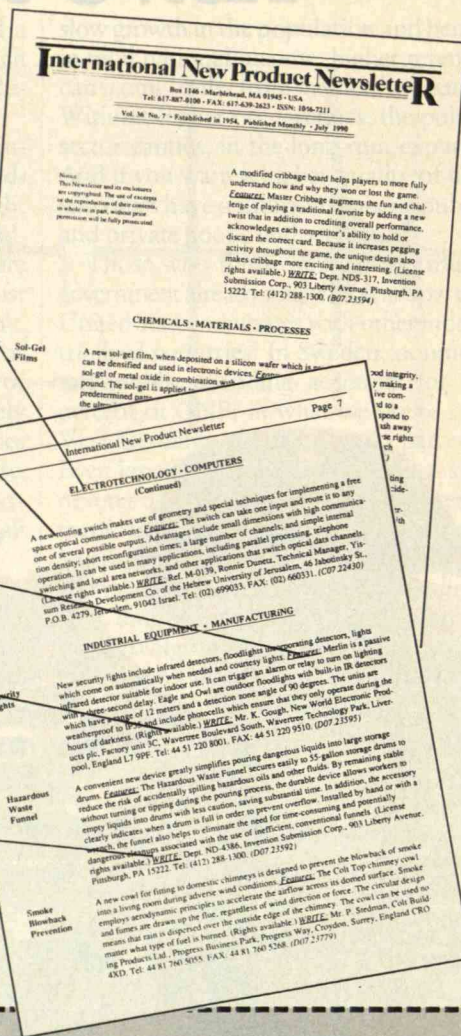
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Reviews

BOOKS

ROTTEN AT THE CORE

The Legacy of Chernobyl
by Zhores Medvedev
Norton, \$24.95

The Truth About Chernobyl
by Grigori Medvedev
Basic Books, \$22.95

BY LAWRENCE M. LIDSKY

THE explosion of Unit Number 4 at the Chernobyl Atomic Energy Station, which took place five years ago this month, has come to symbolize many things: scientific hubris, the danger of the atom, and even the failure of communism. We are constantly warned to learn "the lesson of Chernobyl." But the path leading to the events of April 26, 1986, was so complex that there will be lessons enough for everyone. In *The Legacy of Chernobyl*, by Zhores Medvedev, and *The Truth About Chernobyl*, by Grigori Medvedev, both authors agree on one such lesson: disasters like Chernobyl are the inevitable result of closed, secretive societies where conformity is the rule and independence is punished.

Although both books promise to tell the "truth" about Chernobyl, it is hard to imagine two works more similar in title, subject, and even authors' surnames that are more different. Zhores Medvedev, a dissident biologist expelled from the Soviet Union, has written a detailed and scholarly summary of the physical, ecological, and economic consequences of the Chernobyl accident. Grigori, a physicist and engineer (and no relation to Zhores), has written an extraordinary personal account of the accident based on his own inspection of the site and his interviews with the sick and dying. For Zhores, working from exile in London, Chernobyl was the culmination of the series of hidden ecological disasters he had been writing about



for over a decade. For Grigori, a highly placed member of the Soviet nuclear establishment, it was a chance to fix blame for a remarkably misguided series of technical decisions made by political appointees.

Zhores Medvedev has spent years sifting the available Russian technical literature for clues to information suppressed by the Soviet establishment. He was the first in the West to break the news of the 1957 nuclear catastrophe at the Kyshtim reprocessing plant, which both the Soviet and the U.S. nuclear establishments had hushed up. Like his account of that accident—*Nuclear Disaster in the Urals*—and several similar books he has written, *The Legacy of Chernobyl* has resulted from a careful reading of the open literature interpreted with an exile's knowledge of the society.

As Medvedev ties together more and more apparently unrelated facts, we gradually come to realize the enormous damage Chernobyl has done to the region's agriculture, health, and environment. Over 130,000 people, mostly farmers, have been permanently evacuated. Because of environmental radiation, people in large areas of the Ukraine can no longer eat, plant, or travel without thought of the consequences. Half a million people were exposed to life-shortening doses of radiation, and the effects on several

hundred thousand children subjected to massive, and largely avoidable, doses of radioactive iodine remain to be seen.

Medvedev compares these figures with official accounts to prove that the Soviet government has systematically lied, and is still lying, about the accident's causes and effects. The price of such deception, he writes, is high: "If the Chernobyl catastrophe itself was born of secrecy, many of the mistakes and miscalculations which were made afterwards and which significantly increased the human and economic cost were also the result of secrecy and coverup."

Grigori Medvedev has a different aim in mind: "to reconstruct in authentic detail . . . a picture of the full horror of the Chernobyl nuclear disaster, to revive the dead and maimed and have them return to the control room to relive those tragic hours." He succeeds.

Grigori Medvedev probably knows more about the Chernobyl accident than anyone else on earth. In the early 1970s, he was deputy chief engineer in charge of construction at Chernobyl Unit Number 1. Before that, he had received serious radiation exposure in a laboratory accident and had been hospitalized for months. Fifteen years later, as he interviewed dying Chernobyl victims in the same Moscow hospital ward—even the same bed—he had been in, he could understand their intense pain because he had felt it himself.

At the time of the Chernobyl accident, Grigori Medvedev was in charge of reactor construction at the Central Directory for Power Station Construction in Moscow. On May 8, 1986, just days after the explosion, he was sent to Chernobyl to find out what was happening. He was asked in particular to check on the radiation levels, which his bosses suspected were higher than was being reported. The author drove, at great personal risk, through the town of Pripyat, home of Chernobyl, stopping to measure radiation levels in the streets, and to monitor the half-crazed, starving farm animals wandering through the deserted town. He took readings around the reactor, where unprotected soldiers were picking up pieces of in-



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REVIEWS

tensely radioactive debris by hand because robots had failed.

In an act of incredible bravery, Medvedev even entered the damaged reactor itself, penetrating to the control room of Unit Number 4 to study the position of the control rods at the instant of catastrophe. The air, he writes, was so ionized that it hurt to breathe, and the radiation so intense that his eyelids burned. He then interviewed the people who were in the control room during the accident and those who afterward fought fires at the out-of-control reactor.

Grigori Medvedev's tale, told as a long flashback, climaxes with a minute-by-minute countdown to the accident. He reconstructs the confusion of those present when the reactor unaccountably began to tremble and then, in a series of massive explosions, destroyed itself and its immediate surroundings. He tells of the horrifying effects of radiation on the operators and the firefighters. We learn about the combination of fatigue and nervous excitement that accompanies moderate radiation doses and the telltale "nuclear tan" that portends months in the hospital, or worse. He also damns by name a roster of officials ranging from the deputy chief engineer of the power station to the Soviet minister of energy. It is they whom he holds accountable—whether out of indifference, greed, laziness, stupidity, or stubbornness—for the weakness of the Soviet nuclear program and, ultimately, for dozens of agonizing deaths.

Both Zhores and Grigori have used Chernobyl to tell their stories and to settle old accounts. Yet when we come to the promised lessons of Chernobyl, we find the authors' energies spent.

Zhores meekly concludes that nuclear power is essential, and that therefore we must be more careful. Grigori, after spinning his gripping tale, presents a list of things that must be done. The first item is typical: "The tip switches of the SUZ protection and control rods are to be modified so that, in the fully withdrawn position, the absorber rods will still be inserted into the core to a depth of 47.25 inches." Plati-

tudes and engineering details are not the lessons we had hoped for.

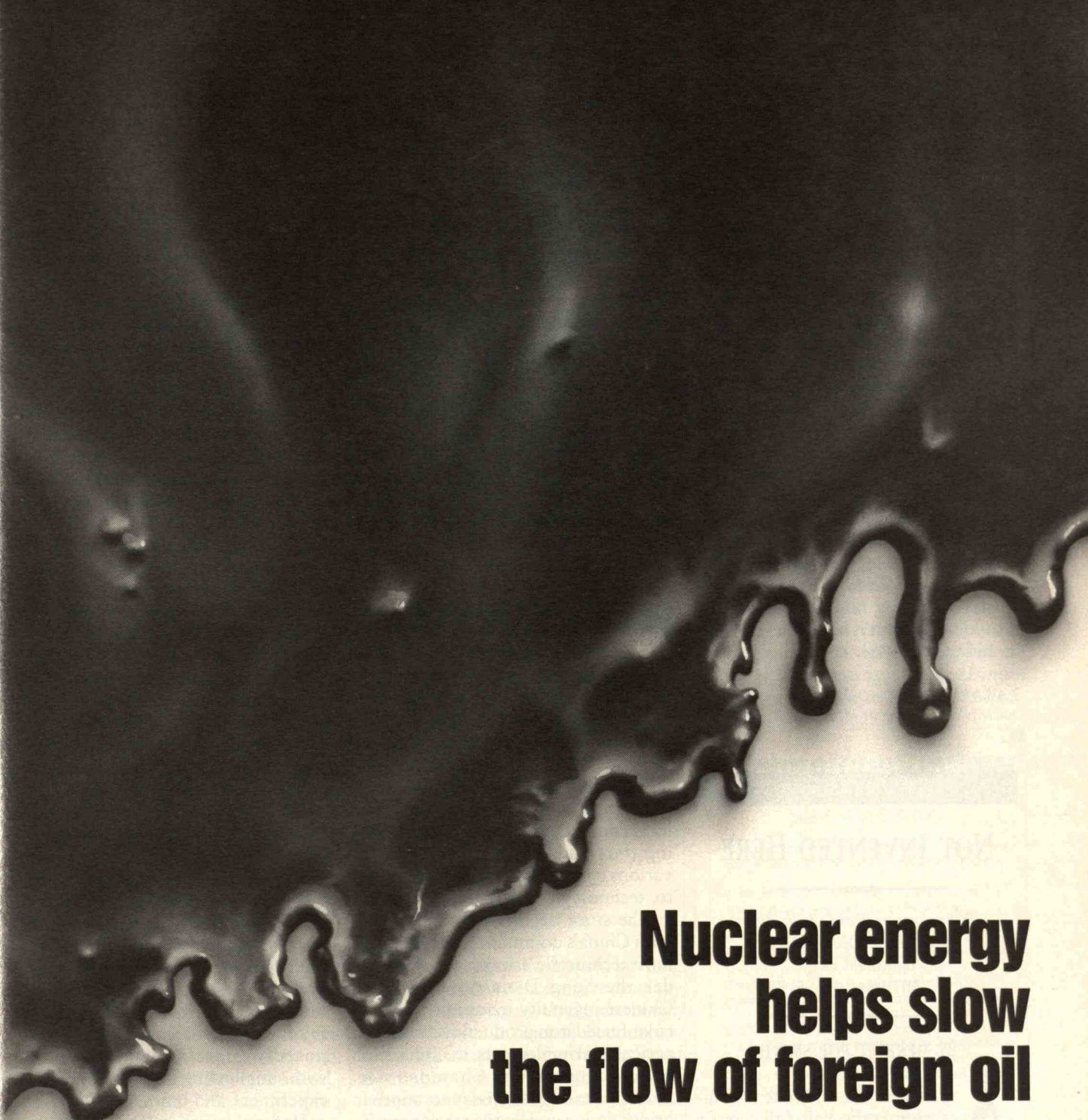
But we can draw our own lessons. The first is that large nuclear accidents are not tolerable—the moral and tangible costs are too high, as both books make plain. The second is that systems that depend on human beings consistently behaving rationally and intelligently will ultimately suffer an "impossible" accident. At all of the world's nearly 500 nuclear reactors, safety depends on workers following elaborate safety procedures. Third, the redundancy built in to reactors gives a false sense of security.

Like Chernobyl and Three Mile Island, all operating nuclear plants rely on the concept of "defense in depth"—an attempt to reduce the probability of total failure by having multiple, redundant, interconnected systems. But beyond a certain level of redundancy, defense in depth is worse than useless. Nuclear plants have come up against the limit.

To illustrate the folly of defense in depth, suppose we wanted to design an airplane in which the chance of all engines failing at once was minimal. We could put on seven engines instead of three. But then more of the engines would have to work to carry the extra weight, and we would need a new control system to operate the complex bank of engines—not to mention a backup safety system for the control system, and a larger power supply and backup, and a new control algorithm for the control computer, and so on. In the end, we would have increased costs enormously, made maintenance far more difficult, and very likely reduced our safety margin. Tellingly, the Chernobyl accident resulted from a test of the reactor's complex safety system.

Nuclear reactors require such a high level of safety that defense in depth becomes untenable. The "inexpensive" reactors of the first nuclear generation, chosen because they had military potential and used cheap components, have turned out—when the full defense-in-depth system is installed—to be very expensive and still not safe enough.

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herently safe" reactors does not rely on human and mechanical perfectibility. These modular gas-cooled reactors are incapable, by the laws of physics, of damaging their cores and releasing radiation. They are much smaller than today's commercial reactors and use a very different technology. Although they have been around for a long time, technology has only recently become available to enable small systems to generate electricity at a competitive cost.

Unfortunately, the nuclear establishment views these reactors as a threat. Any reactor designated inherently safe carries a strong implication about existing reactors: that they are inherently dangerous. And indeed they are. The industry has been hoping that no one would notice, but it has been very hard to hide Chernobyl. ■

LAWRENCE M. LIDSKY is a professor of nuclear engineering at MIT.

BOOKS

NOT INVENTED HERE

*Technology in World Civilization:
A Thousand-Year History*
by Arnold Pacey
MIT Press, \$19.95

BY MERRITT ROE SMITH

A persistent bias in Western civilization is the belief that most major developments in technology originated in the West and were simply transferred to other, presumably "less developed" cultures. This premise, coupled with the emphasis educators have long placed on the centrality of the "Western intellectual tradition," has given rise to a pervasive belief in the West's technical dominance and encouraged feelings of moral, political, and racial superiority.

In *Technology in World Civilization: A Thousand-Year History*, Arnold



Pacey, a British physicist-turned-historian, challenges this Eurocentrist perspective. His implicit message is that the West's technological debt to other cultures is at least as great as the other way around. What's more, he develops an important hypothesis about why technological transfers between East and West succeeded in some instances and not in others: that in order for transferred technology to "take," the receiving culture must be able to adapt it to local conditions. The result is an engaging thousand-year panorama of how various cultures initiated, and adapted to, technological change.

The story begins around 1000 AD with China's dominance as the world's most technically advanced region. Under the Song Dynasty (960–1126), Chinese ingenuity manifested itself in coke-fueled iron production, advanced agricultural implements, the cultivation of quick-growing Champa rice, monumental canals, and innovations in bridge design and textile machinery. Indeed, Pacey observes that "in all these fields, there were techniques in use in eleventh-century China which had no parallel in Europe until around 1700." Even during the Mongol invasions of the twelfth and thirteenth centuries, China and some of its neighbors continued to innovate in agriculture, papermaking, printing, gunpowder weaponry, and shipbuilding.

Besides native ingenuity, a major stimulant to China's technological prowess was its trade links with other

technically advanced cultures in the Persian Gulf, India, and Southeast Asia. China's willingness to adapt ideas from other cultures proved critical to its success as a technological innovator. Throughout the book, Pacey emphasizes that the most innovative societies are those that are responsive to new technical knowledge and "interrogate" it "on the basis of their own experience and knowledge of local conditions." In the resulting "technological dialogue," borrowed techniques stimulate invention on the part of the receiving culture.

Such creative exchanges occurred between China, Iran, and India in the Song period, between India and Europe in the eighteenth century, between Japan and the West after 1868, and between the West and Korea, Taiwan, China, and other Pacific Rim countries in the twentieth century. A prime example is the European invention of cannon following the transfer of gunpowder recipes and some primitive handguns from China in the fourteenth century.

Technology transfer doesn't always result in creative dialogues, however. Pacey cites this century's Green Revolution, whereby international organizations have attempted to boost crop yields in the Third World. The enterprise failed in Africa, he argues, partly because "plant breeders did little work on locally important crops." More important, Western agriculturalists "too often tended to think in terms of imposing transfers of technology from supposedly more 'advanced' regions without allowing for local knowledge, experiment and innovation."

Under colonialism, India fared worse still. British rule effectively stifled the country's creative technological impulses through an enforced policy of deindustrialization. Before becoming a British colony in the eighteenth century, India had thrived as a leading producer of textiles, ships, and metal objects—so much so that Britain had viewed it as a serious economic competitor. But as a colony, India was expected to be a source of raw materials and a market for the mother country's industrial products. Pacey concludes

that "India was forced to conform to the concept of 'transfer of technology' in its crudest form, in which one party is seen as a passive borrower of techniques, not a participant in dialogue."

While Pacey is critical of the West's insatiable quest for control through technology, he nonetheless ends on a positive note. "The dialogue continues," he writes. Even as we move toward becoming a single world civilization, we are becoming increasingly aware that "the practice of technology involves social choices and managerial procedures, and is thereby culturally conditioned." This new awareness is perhaps most evident in the "appropriate-technology" movement, which, since the 1960s, has made important studies in Africa, Burma, India, and other parts of the world.

In a study of such scope, one is bound to detect certain weaknesses. In his treatment of technological change, for example, Pacey tends toward a top-down perspective that neglects the contributions and concerns of working people. Only once does he mention the problems that inevitably arise between workers and managers over new technologies, and then only with a brief reference to "discipline and organization" in the eighteenth-century British textile industry.

More important, his chapter entitled "Scientific Revolutions and Technical Dreams" probes the role of technological enthusiasm among scientists and engineers, only to get trapped in an uncritical discussion of great men and their inventions. Hence Rudolph Diesel, Otto von Lilienthal, Hiram Maxim, and Werner von Braun are characterized as technological dreamers who translated brilliant insights into brilliant inventions—but there the matter rests. Pacey does not take the extra step and consider how the pursuit of elegant solutions in the lab and at the workbench can produce instruments of economic, military, and political conquest, and ultimately how these drives relate to his Eurocentrist critique and the larger theme of technological dialogue.

But these are minor faults in view of what Pacey has accomplished. Many

historians have written about the transfer of technology across national and regional boundaries and assessed their economic consequences. Pacey is among the first to examine the phenomenon from the larger perspective of world history and to explore how political and economic policies and cultural conditions affect technological change. His concept of technological dialogue is an important insight that will doubtless elicit further research. ■

MERRITT ROE SMITH is a professor in MIT's Program in Science, Technology, and Society, and past president of the Society for the History of Technology.

BOOKS

BETTER LIVING THROUGH SCIENCE

*Making Science Our Own:
Public Images of Science 1910-1955*
by Marcel C. LaFollette
University of Chicago Press, \$17.95

BY WADE ROUSH

THE industrialized world has long equated science and technology with progress. And even though National Science Foundation surveys show a rise in the proportion of the public who believe the harm of science and technology outweighs the benefits—from 11 percent in 1979 to 19 percent in 1987—it appears that vast numbers of Americans still see science and technology as largely responsible for their high standard of living.

This belief does not result entirely from the actual material benefits brought by science and technology—labor-saving devices, plentiful food, improved health. Since the beginning of this century, journalists and scientists themselves have cultivated a positive image of science in the national media. In a perceptive, yet limited, look at the fan-

tasy realm of science created in the pages of mass-circulation magazines, Marcel C. LaFollette shows that what is at stake for these communicators is not simply the public's willingness to devote resources to scientific and technological development, but the autonomy and social status of a whole profession.

Until the middle of the century, magazines like *Collier's*, *Harper's*, the *Atlantic Monthly*, and the *Saturday Evening Post* were ubiquitous in literate households. These periodicals, instrumental in creating the picture of science in the public imagination, painted scientists as virtual demigods, heroes for a new age of progress whose pursuits were as beneficial to society as they were distant and arcane.

In *Making Science Our Own*, LaFollette, former editor of the journal *Science, Technology, and Human Values*, presents the results of her exami-

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nation of hundreds of articles from 11 magazines published between 1910 and 1955—the approximate period of their ascendancy in the mass media, and also a time when much of modern science policy was being drafted. She explains how scientists encouraged worshipful descriptions of their work, and how these descriptions translated into political support for science.

After World War I, for example, chemist Edwin E. Slosson founded a nonprofit news syndicate to promote favorable views of science. The Science Service, as it was called, won the sponsorship of the American Association for the Advancement of Science and the National Research Council. Slosson asserted that the service did not engage in propaganda “unless it be propaganda to urge the value of research and the usefulness of science.”

The national magazines ran almost as many science articles written by scientists as by journalists, giving yesterday’s Carl Sagans—the likes of physicist Robert Millikan and astronomer Harlow Shapley—the opportunity to preach about the importance of autonomous, well-funded scientific institutions such as universities at the same time as they popularized scientific subjects from archeology to atomic energy.

Scientists provided a highly selective and idealized picture of their world. The typical “man of science” (and he was, invariably, a white male) possessed razor-sharp intelligence, an insatiable curiosity, a cold and mechanical mindset, and saintly patience. Scientists cultivated this “myth of differentness,” though perhaps unconsciously, because it aroused feelings of awe, respect, even fear. The public’s submissiveness, says LaFollette, could be parlayed into a continuing, no-strings-attached support for scientific research.

The magazine stories, especially those penned by journalists, obscured scientists’ methods and tools as much as their personalities. Writers tended to use the same images repeatedly—“orderly racks of test tubes lining the black, unpolished work tables, the many-sized chemical bottles crowding the



shelves”—to glamorize and legitimate the scientific environment. Comprehensive inaccuracy usually won out over incomprehensible accuracy as articles described scientists’ patterns of investigation in terms so vague as to be meaningless. The scientific method was “mainly a matter of knowing a certain number of facts, putting them together in many different ways, and adding up the results correctly,” the *American Magazine* blithely professed in 1949.

Science was not immune to criticism from magazine writers, although the proportion of articles with critical themes was small (between 5 and 10 percent, LaFollette finds). Articles sometimes scolded scientists for using obscure jargon: most science “is printed in a foreign language not only when it appears in French or Japanese, but also when it seems at first sight to be in ordinary English,” complained chemist Slosson in 1922. Scientists were also criticized for overspecializing, for being indifferent to the applications of their work, and for setting up an authority system to rival religion.

Not until after Hiroshima and Nagasaki did a deeper ambivalence surface and did scientists’ promises about the equivalence between research and social progress become more suspect. The same scientists who probed the heart of the atom, wrote journalist James R. Newman in 1947, “can only guess at the scope of the application of the power they have won; and they

profess no confidence at all in predicting the social, economic, and political consequences of their discovery.”

Today, suspicion of science and technology seems to have a foothold among a small but significant slice of the public, as illustrated by the National Science Foundation surveys—and by grassroots events such as Earth Day, with its message that technology is fouling the global environment. Scientists brought this failure of confidence upon themselves, LaFollette says, by promising a future without war, hunger, and disease.

A gap between expectations and reality no doubt exists, and LaFollette documents it thoroughly. But magazine articles themselves convey only part of the complex relationship between science and the American public in this century. It remains for other scholars to do the difficult work of illuminating just how much readers were influenced by what they read. An assumption common among media researchers—which LaFollette accepts—is that the content of magazine articles accurately reflected popular attitudes while also shaping those attitudes. Scientists, according to this view, could only have strengthened, rather than created, the public perception of equivalence between science and progress. But a fundamental task that social historians have yet to tackle is to “step out of the loop” to explore the prime sources of such perceptions.

One source may be the actual technical content of science stories, as opposed to the way such articles portray scientists. The post-World War II perception that the atom could be domesticated as a source of safe, abundant, and cheap electricity, for instance, may be traceable to the enthusiastic—and selective—coverage of the subject by *New York Times* science writer William Laurence and others. Hard technical data are less compelling and more difficult to sort through than grand images, but they may be just as critical in forging public perceptions. ■

WADE ROUSH is a free-lance writer and a doctoral student in MIT’s Program in Science, Technology, and Society.

otherwise unanimous U.N. resolutions.

Also, as Secretary of State James Baker points out, there is a link between the gulf action and what is transpiring in Israel, the West Bank, Gaza, and Lebanon. The proximity of those areas to Iraq and Kuwait, along with the ethnic relationships in the area, make the situation about as safe as a powder keg near an open flame. Forsberg chooses to ignore all that.

Moreover, Forsberg's faith that a civilian economy could replace the existing worldwide military economy is misguided. After World War II, civilian goods were in short supply for about five years, and producing them provided a fair number of jobs. But after that the Korean police action had to be initiated to prevent excessive unemployment. And after that it was the Vietnam War, then the glorified WPA trip to the moon, then the Committee on the Present Danger and the window of vulnerability, then the Evil Empire and the imminent invasion of Texas, then the drug war, and now Saddam-Who-Makes-Hitler-Appear-Decent-by-Comparison.

The point is that military production is self-perpetuating: the products are expendable, so the need for manufacturing is constant. Much of civilian production, on the other hand, is durable, which leads to economic stagnation. Perhaps the only places on earth where the civilian economy isn't already bloated from overproduction are the recently liberated Eastern European countries, and the people there are in no position to purchase necessities of life, much less luxuries that would help the world economy.

All this works to reinforce the apparent need for military production. Until the current setup is replaced by something of value, we have no hope. Even people who work in extremely hazardous nuclear weapons plants would rather do that than face the spectre of unemployment. Therein lies the power of the military-industrial complex.

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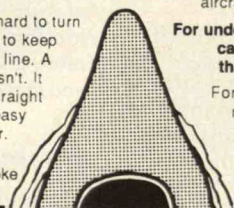
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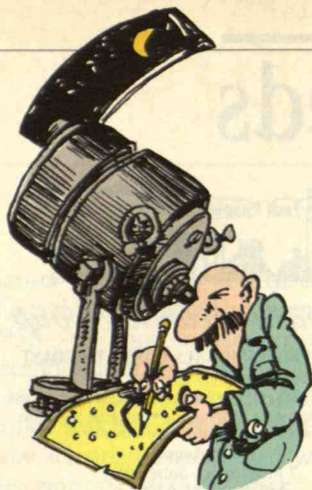
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Notes



Sky Map

Astronomers have begun a project to map the universe 100 times more thoroughly than ever before. The Astrophysical Research Consortium (ARC), which includes six universities and research centers, is compiling a digital sky survey to help explain how galaxies formed. It should also settle debates about whether clusters of galaxies are arranged in sheets, bubbles, or other large-scale structures. For the 10-year survey, the ARC will combine a wide-angle telescope, a gigantic digital camera, and a robot-controlled spectrograph.

The survey will produce a 3-D map of 1 million galaxies, 100,000 quasars, and numerous intergalactic gas clouds. It will also produce a two-dimensional color map of 100 million galaxies.

Chemical Canaries

University of Connecticut physiologist Joseph Crivello is field testing a film badge to alert wearers of cancer-causing chemicals. Much as canaries once warned of fumes in mines, the badge replicates what occurs when a carcinogen causes a tumor to form in a human body. The badge, which looks like those worn to detect radiation, changes color when exposed to dangerous levels of more than 130 compounds.

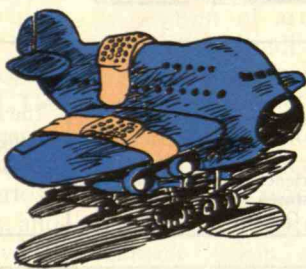
This could be the first sensor to warn of unknown toxic hazards easily and inexpensively. Workers at Superfund sites and other toxic cleanups now rely on bulky monitors that detect only specific chemicals.

Drug Treatments

The war on drugs would be more effective if more of the estimated 5.5 million Americans who need treatment could get it on a timely basis, if public treatment services were better, and if public and private expenditures were better managed, according to an Institute of Medicine committee. The benefits, especially in reducing crime, would far outweigh the costs.

The committee recommends much higher funding for public programs to enhance the quality and evaluation of treatment workers, reach out to 105,000 pregnant women and young mothers who need treatment, and expand treatment for 1 million prisoners, probationers, and parolees.

About 66,000 people are on waiting lists for public programs, plus "hundreds of thousands who do not apply for treatment," says Dean Gerstein, the report's study director.



Airplane Band-Aid

Bucknell University mechanical engineer David Cartwright and his colleagues at England's Royal Aerospace Establishment are working on fiber-reinforced adhesive patches to stop the growth of small cracks in structures. This high-tech Band-Aid could prolong the life of airplanes, bridges, and other highly stressed structures.

Cartwright is seeking an adhesive patch that could bear

a heavier load than riveted metallic patches. Also, the more rivets, the better the patch, and "an adhesive is like an infinite number of rivets," he explains. Another advantage of the adhesive patch is that it "provides a smoother surface on the plane and becomes more a part of the structure itself."

Monitoring Minus

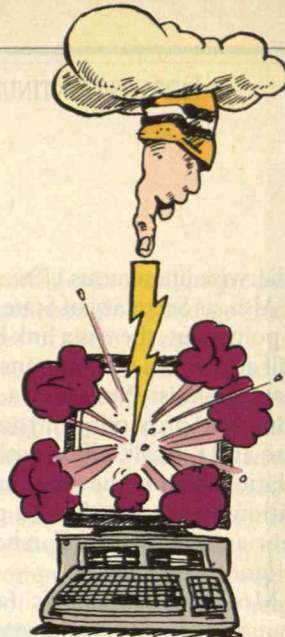
"Video display terminal operators are more likely to have health problems if they are electronically monitored," reports *Work in America*. A study conducted by the Communications Workers of America and University of Wisconsin researchers found that monitored workers are more bored, tense, anxious, angry, tired, and depressed than unmonitored workers. They are also more susceptible to headaches and musculoskeletal problems.

Unclear Clear-Cuts

The timber industry has long held that cutting all the trees in an area speeds the growth of food for deer and elk. But 10 years of research led by Washington State University wildlife biologist Charles Robbins indicates otherwise.

Robbins has found that plants in clear-cuts are usually less nutritious than those in old-growth forests. For example, huckleberry, one of the most prevalent browsing foods in southeast Alaska, grows faster in clear-cuts, but its nutrients are more dilute. Notes Robbins, "Small changes in the food available can have a major effect on the viability of the fetus or fawn."

What's more, says Robbins, clear-cuts present other hazards. "Whether it is a cold winter or a hot summer day, the clear-cut is a much harsher environment."



According to God

God Business Solutions, Inc., of Bellevue, Wash., has updated its "Ask God" computer program. *Sojourners* magazine reports that Version 4.0 of the Bible study program incorporates artificial-intelligence software that can answer queries.

Sojourners suggests a few nagging questions to pose—"Yo, God. Why are peach pits poisonous?"

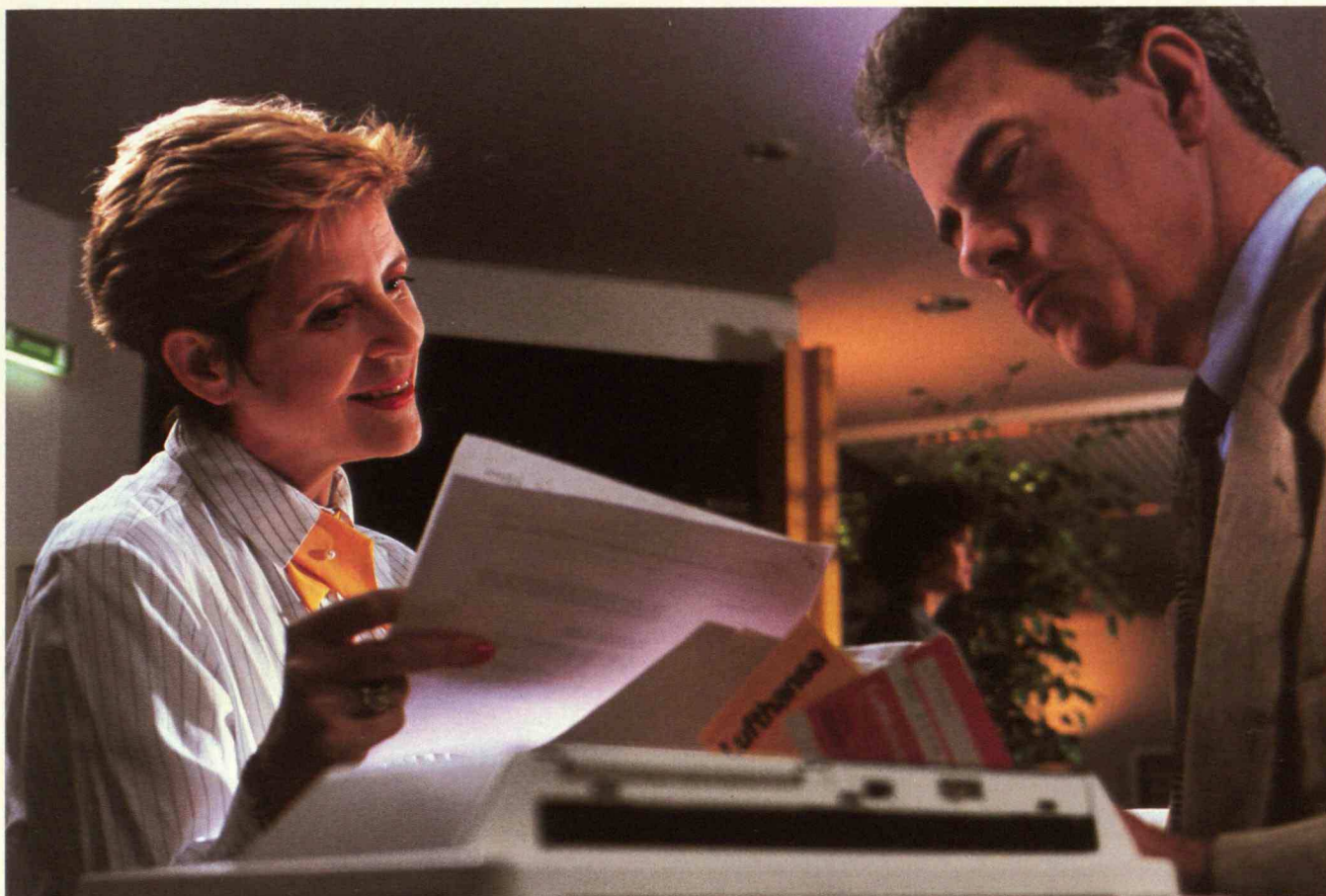
"And how come salt and saturated fat taste so darn good?"

Agricultural Origins

Yale archeologists Frank Hole and Joy McCorriston have pinpointed agriculture's origins to an area near the Dead Sea where they think farmers cultivated wheat and barley 10,000 years ago. Some scientists argue that humans began cultivating crops gradually, starting perhaps 20,000 years ago, but Hole says farming appeared "almost instantaneously" throughout the Near East.

"The precursors of agriculture—available wild grains, technology, social organization, and need—have been found together nowhere else at an earlier date," he says. Learning to mill wild grains, whose large seeds could survive dry summers, enabled early farmers to make wheat and barley staples of their diets.

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